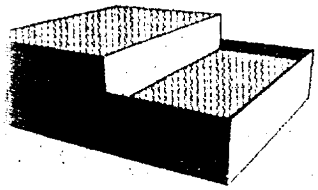
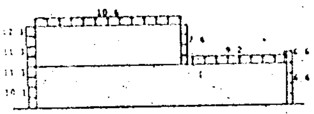
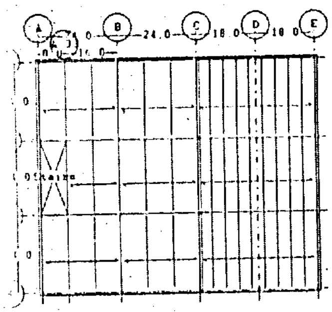
AD-A254 137

US Army Corps of Engineers







COMPUTER AIDED STRUCTURAL ENGINEERING (CASE) PROJECT

INSTRUCTION REPORT ITL-92-3

CONCEPT DESIGN EXAMPLE, COMPUTER AIDED STRUCTURAL MODELING (CASM)

Report 3

SCHEME C

by

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DEPARTMENT OF THE ARMY
Waterways Experiment Station, Corps of Engineers
3909 Halls Ferry Road, Vicksburg, Mississippi 39180-6199

June 1992

Report 3 of a Series

Prepared for DEPARTMENT OF THE ARMY
US Army Corps of Engineers
Washington, DC 20314-1000

Under Contract No. DACA39-86-C-0024
(RDT&E Program, Work Unit No. AT40-CA-001)

C

Monolithic Concrete For Two Story Portion,
Steel For Lower Roof Portion,
Lateral Load Resistance = Shear Walls

Table of Contents for Scheme C

Preface

This manual presents a detailed design example emphasizing major capabilities of the Computer Aided Structural Modeling (CASM) computer program which is a program designed to aid the structural engineer in the preliminary design and evaluation of structural building systems by the use of three-dimensional interactive graphics.

Funds for the development of this program were provided to the Information Technology Laboratory (ITL), US Army Engineer Waterways Experiment Station (WES), Vicksburg, MS, by the Directorate of Military Programs, Headquarters, US Army Corps of Engineers (HQUSACE), under the Research, Development, Test, and Evaluation (RDT&E) program. The work was accomplished under Work Unit No. AT40-CA-001 entitled "CASE (Computer Aided Structural Engineering) Building Systems." The work was performed by members of Wickersheimer Engineers, Inc., of Champaign, IL, under Contract No. DACA39-86-C-0024.

Funds for publication of this report were provided to ITL under the RDT&E Program and CASE Project.

Specifications for the program were provided by members of the Building Systems Task Group of the CASE Project. The following were members of the task group during this phase of program development:

Mr. Dan Reynolds, US Army Engineer (USAE) District, Sacramento (Chairman)
Ms. Anjana Chudgar, USAE Division, Ohio River
Mr. Pete Rossbach, USAE District, Baltimore
Mr. Gary Close, USAE District, Savannah
Mr. Dave Smith, USAE District, Omaha
Mr. Mark Burkholder, USAE District, Tulsa
Mr. Jerry Maurseth, USAE District, Portland
Mr. Young Hsu, USAE District, Memphis
Mr. Michael Pace, WES

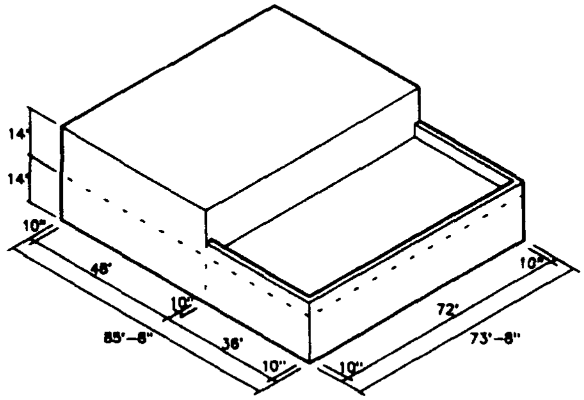
The computer program was written by Messrs. David Wickersheimer, Gene McDermott, and Carl Roth of Wickersheimer Engineers, Inc.

This report was written by Messrs. Wickersheimer, McDermott, and Roth and Mr. Michael E. Pace, Computer-Aided Engineering Division (CAED), ITL, WES.

The work was monitored at WES by Mr. Pace, under the general supervision of Mr. H. Wayne Jones, Chief, Scientific and Engineering Applications Center; and Dr. N. Radhakrishnan, Director, ITL. Mr. Charlie Gutberlet is the HQUSACE Technical Monitor.

During publication of this report, Dr. Robert W. Whalin was Director of WES. COL Leonard G. Hassell, EN, was Commander and Deputy Director.

Project Description



This 1 and 2 story project is to provide approximately 9,500 gross square feet of office space for one of two possible sites:

(a) Charleston, South Carolina

(b) Radford AAP, Virginia

Soil conditions are unknown at both sites.

The following project criteria has been established:

1. The 36' x 72' space on the first level shall be column free for open office planning.

2. The 48' x 72' first and second floor areas shall provide 24' square bays.

3. The first floor shall be a slab on grade with the tops of perimeter continuous wall footings set at 2'-6" below grade. Column footings will be isolated spread footings.

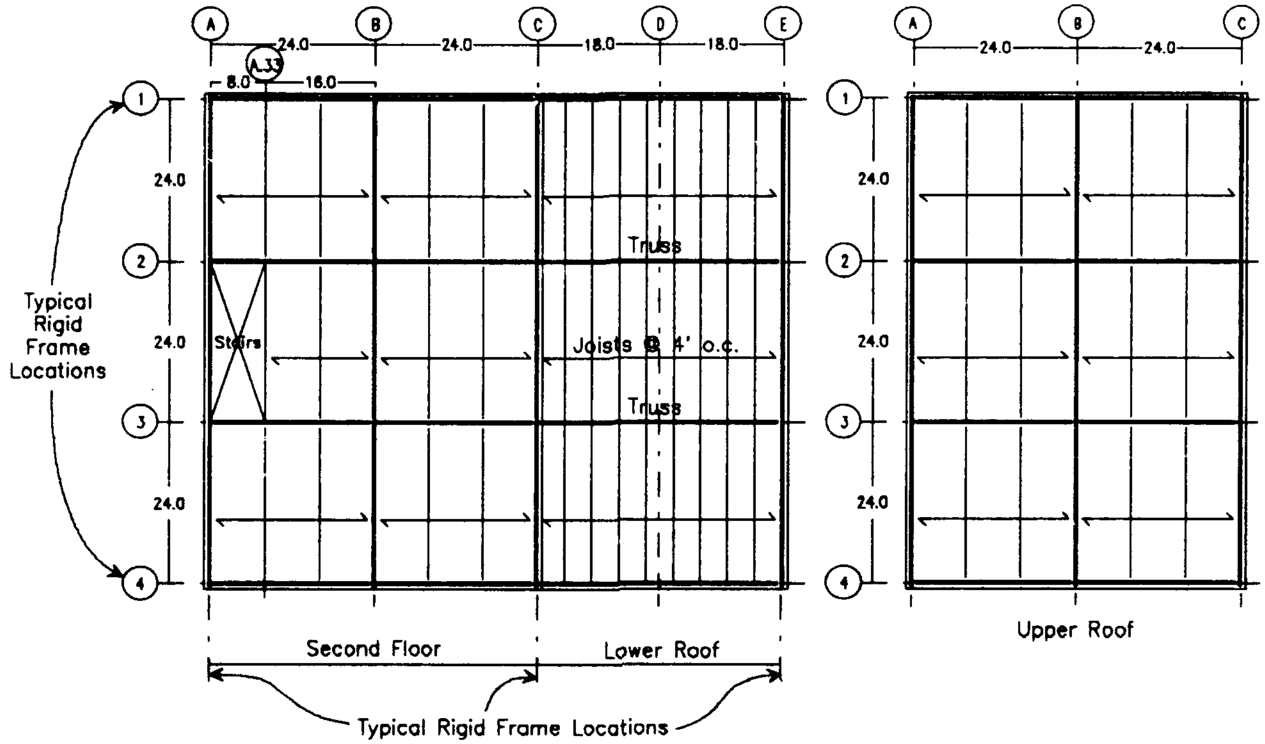
4. The second floor occupancy live loads located on the plan are:

Offices:	50 psf
File Storage:	150 psf
Corridor, Stair & Lobby:	100 psf

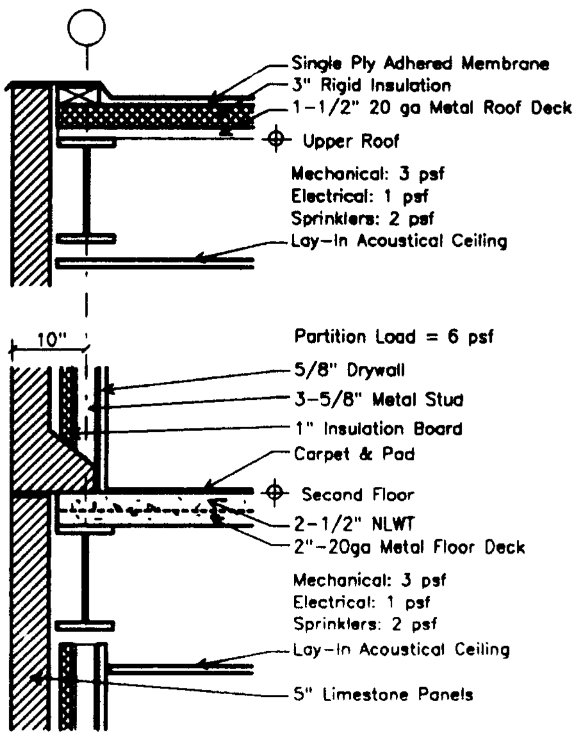
5. Structural framing schemes to be designed and compared shall be as follows:

Scheme A:	All steel, non-composite, lateral load resistance = rigid frames.
Scheme B:	All steel, composite, lateral load resistance = X braced frames.
Scheme C:	Monolithic concrete for two story portion, steel for lower roof portion, lateral load resistance = shear walls.

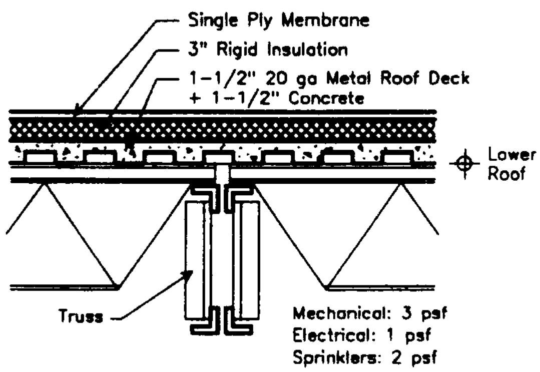
Scheme A



A B C D E
24.0 24.0 18.0 18.0
A.33
8.0 16.0
1 2 3 4
24.0
24.0
24.0
Typical Rigid Frame Locations
Stairs
Truss
Joists @ 4' o.c.
Truss
Second Floor
Lower Roof
Typical Rigid Frame Locations
A B C
24.0 24.0
Upper Roof

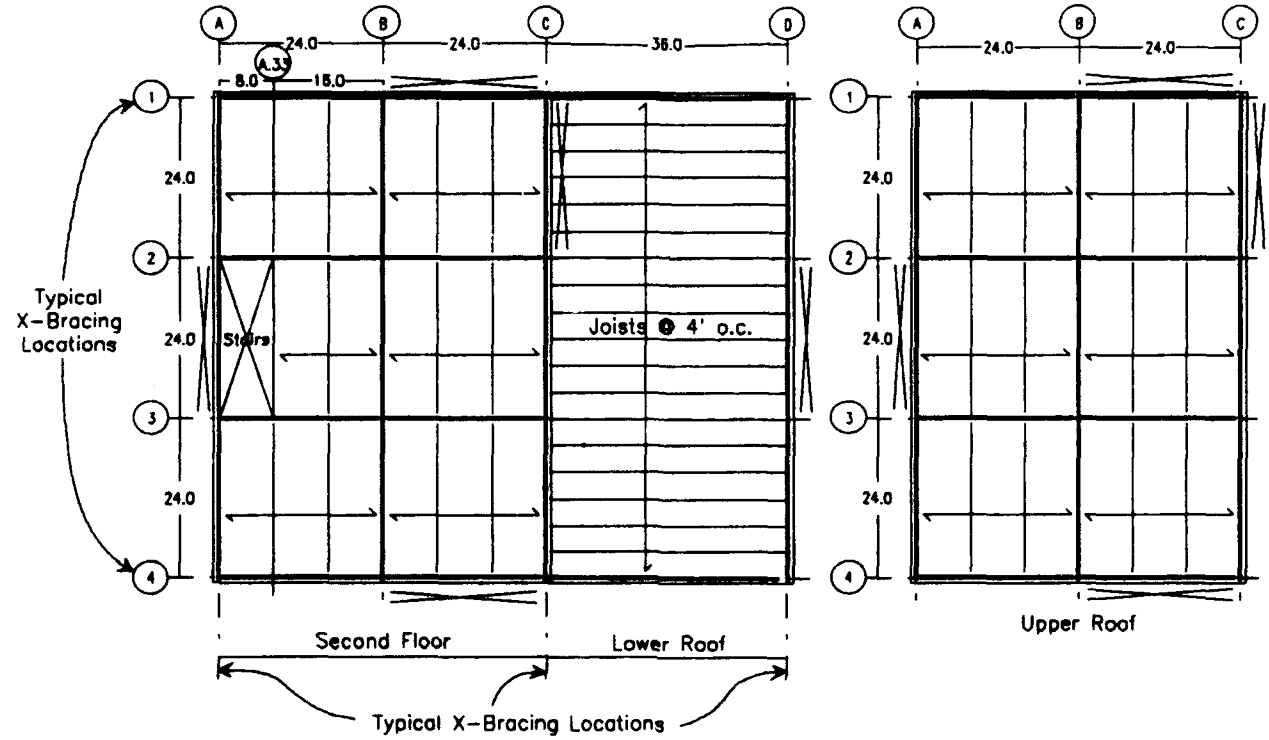


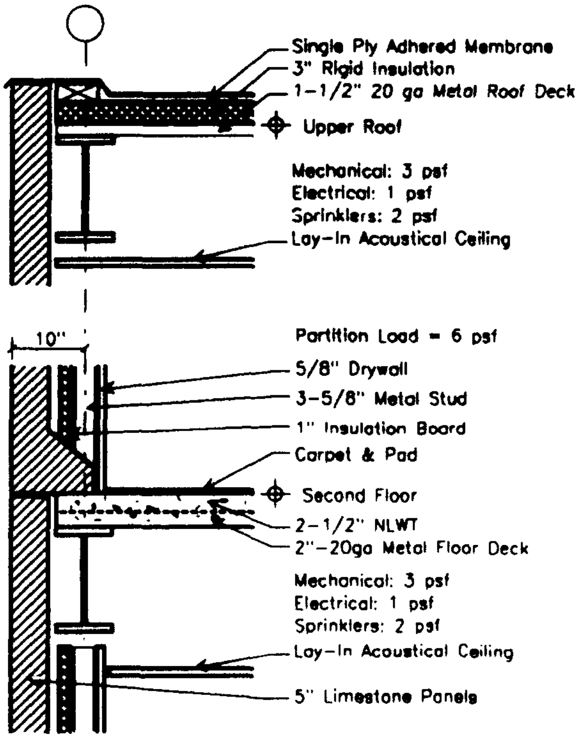
Single Ply Adhered Membrane
3" Rigid Insulation
1-1/2" 20 ga Metal Roof Deck
Upper Roof
Mechanical: 3 psf
Electrical: 1 psf
Sprinklers: 2 psf
Lay-In Acoustical Ceiling
10"
Partition Load = 6 psf
5/8" Drywall
3-5/8" Metal Stud
1" Insulation Board
Carpet & Pad
Second Floor
2-1/2" NLWT
2"-20ga Metal Floor Deck
Mechanical: 3 psf
Electrical: 1 psf
Sprinklers: 2 psf
Lay-In Acoustical Ceiling
5" Limestone Panels

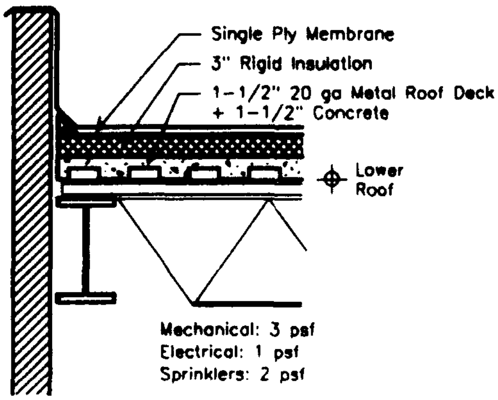


Single Ply Membrane
3" Rigid Insulation
1-1/2" 20 ga Metal Roof Deck
+ 1-1/2" Concrete
Lower Roof
Truss
Mechanical: 3 psf
Electrical: 1 psf
Sprinklers: 2 psf

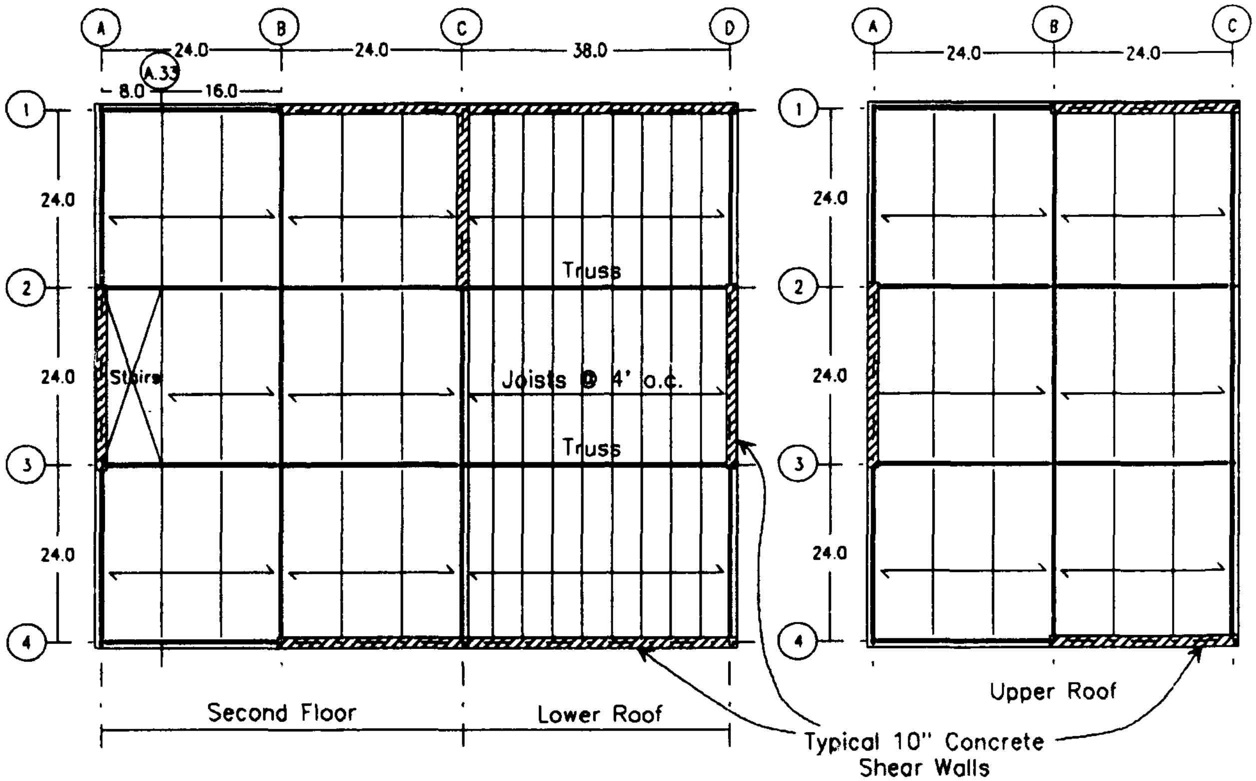
Scheme B

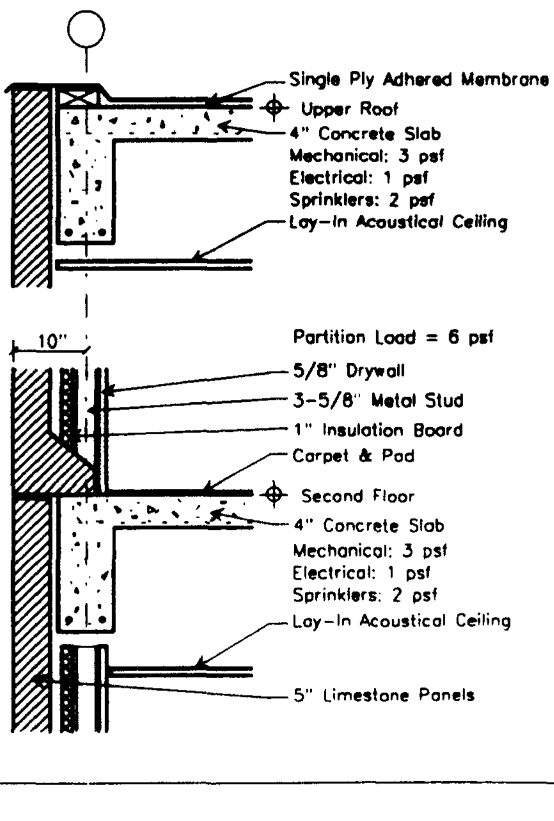

Typical X-Bracing Locations
24.0
24.0
36.0
8.0
16.0
A.33
Stairs
Joists @ 4' o.c.
Second Floor
Lower Roof
Upper Roof
Typical X-Bracing Locations

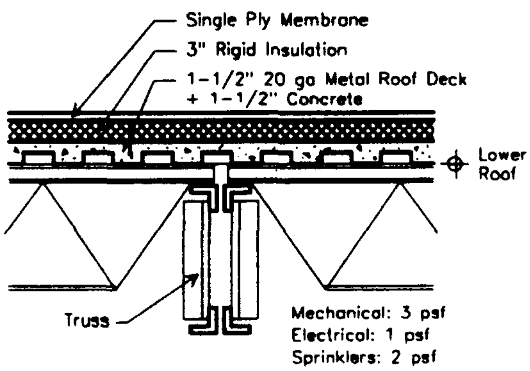

Single Ply Adhered Membrane
3" Rigid Insulation
1-1/2" 20 ga Metal Roof Deck
Upper Roof
Mechanical: 3 psf
Electrical: 1 psf
Sprinklers: 2 psf
Lay-In Acoustical Ceiling
10"
Partition Load = 6 psf
5/8" Drywall
3-5/8" Metal Stud
1" Insulation Board
Carpet & Pad
Second Floor
2-1/2" NLWT
2"-20ga Metal Floor Deck
Mechanical: 3 psf
Electrical: 1 psf
Sprinklers: 2 psf
Lay-In Acoustical Ceiling
5" Limestone Panels


Single Ply Membrane
3" Rigid Insulation
1-1/2" 20 ga Metal Roof Deck
+ 1-1/2" Concrete
Lower Roof
Mechanical: 3 psf
Electrical: 1 psf
Sprinklers: 2 psf

Scheme C


A
B
C
D
24.0
24.0
38.0
A.33
8.0
16.0
1
2
3
4
24.0
24.0
24.0
Truss
Stairs
Joists @ 4' o.c.
Truss
Second Floor
Lower Roof
A
B
C
24.0
24.0
Upper Roof
Typical 10" Concrete Shear Walls


Single Ply Adhered Membrane
Upper Roof
4" Concrete Slab
Mechanical: 3 psf
Electrical: 1 psf
Sprinklers: 2 psf
Lay-In Acoustical Ceiling
10"
Partition Load = 6 psf
5/8" Drywall
3-5/8" Metal Stud
1" Insulation Board
Carpet & Pad
Second Floor
4" Concrete Slab
Mechanical: 3 psf
Electrical: 1 psf
Sprinklers: 2 psf
Lay-In Acoustical Ceiling
5" Limestone Panels


Single Ply Membrane
3" Rigid Insulation
1-1/2" 20 ga Metal Roof Deck
+ 1-1/2" Concrete
Lower Roof
Truss
Mechanical: 3 psf
Electrical: 1 psf
Sprinklers: 2 psf

6. The typical exterior envelope consists of 5" limestone panels, 1" rigid insulation, 3-5/8" metal studs, and 5/8" drywall.

7. Window and door openings are uniformly distributed to all elevations.

8. Load Assumptions:

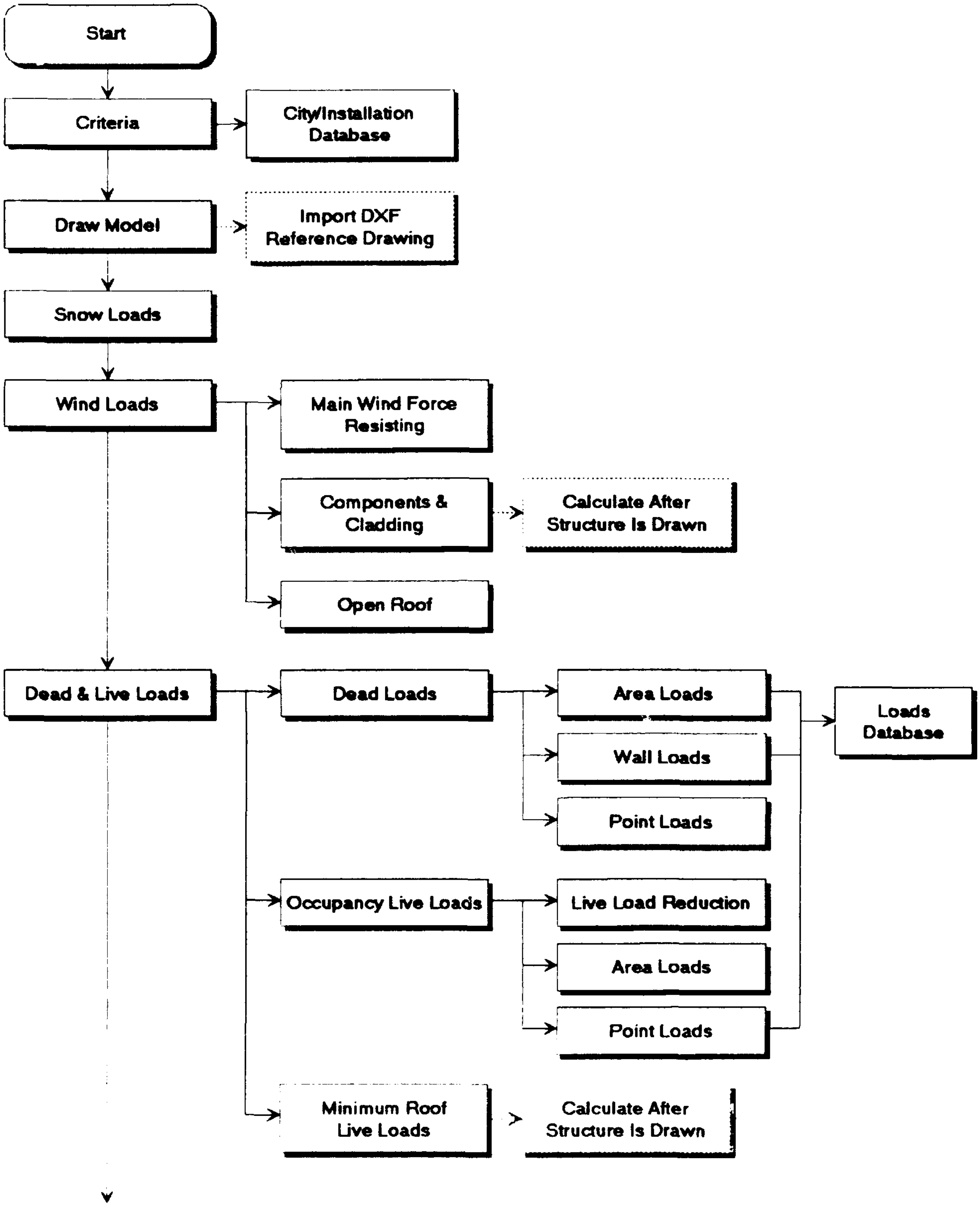
	Importance Category	Exposure Category
Snow:	I	C
Wind:	I	C
Seismic:	IV	

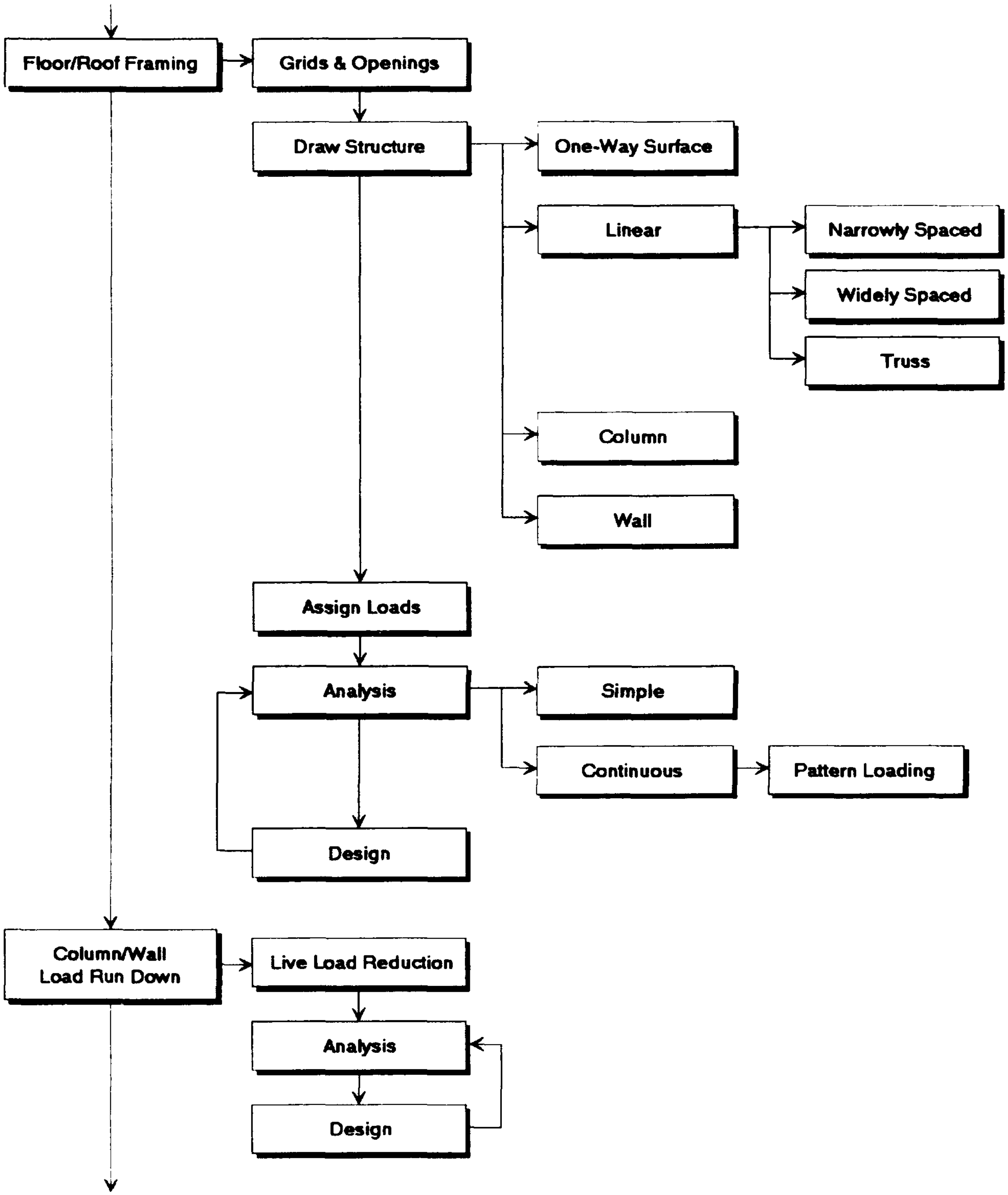
9. Material Assumptions:

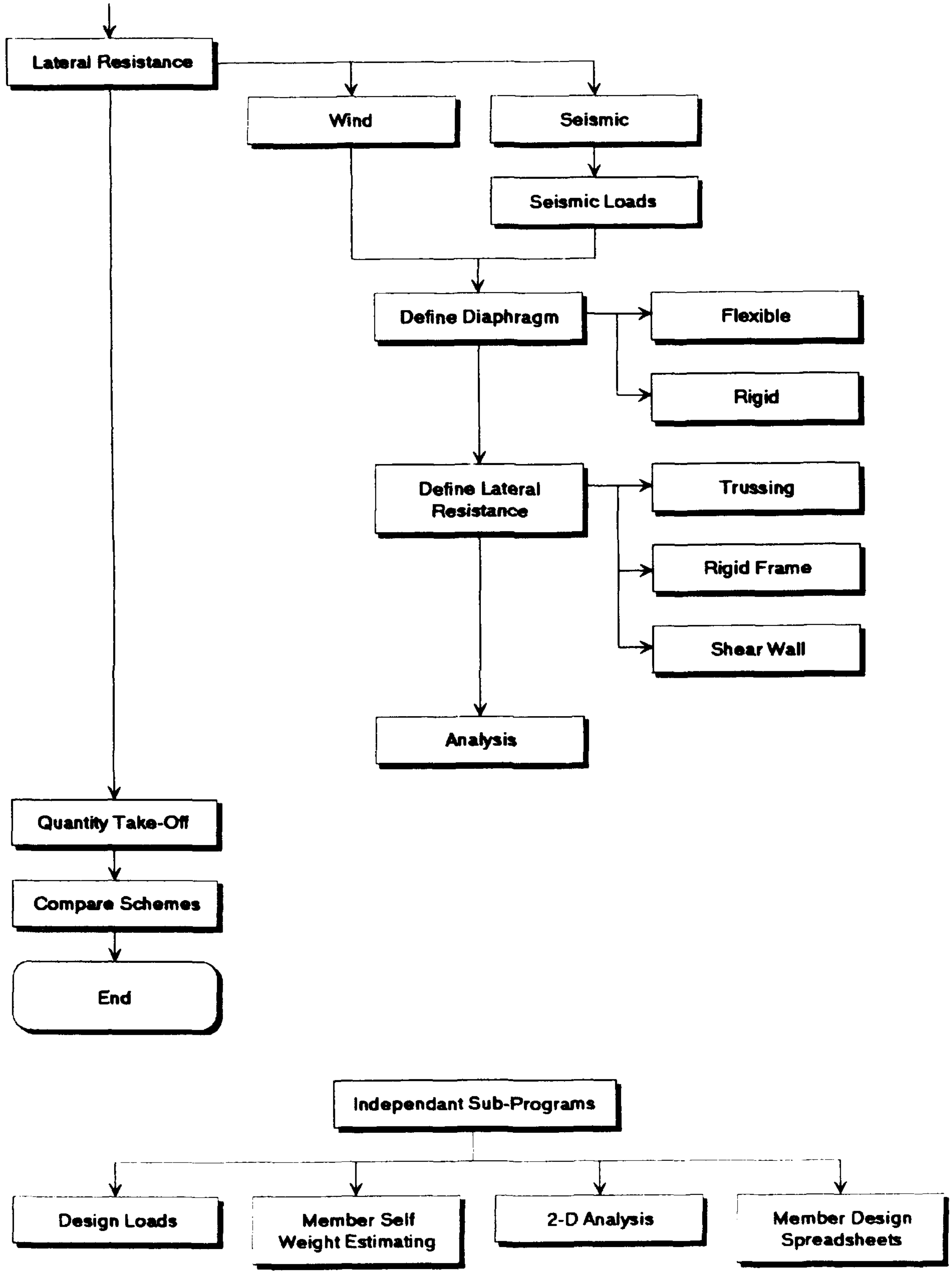
Concrete:	4,000 psi, NLWT
	Steel Reinforcing: Grade 60
Steel:	A36

10. Fire resistance rating shall be achieved by a wet sprinkler system.

Computer Aided Structural Modeling




Floor/Roof Framing
Grids & Openings
Draw Structure
One-Way Surface
Linear
Narrowly Spaced
Widely Spaced
Truss
Column
Wall
Assign Loads
Analysis
Simple
Continuous
Pattern Loading
Design
Column/Wall
Load Run Down
Live Load Reduction
Analysis
Design


Lateral Resistance
Wind
Seismic
Seismic Loads
Define Diaphragm
Flexible
Rigid
Define Lateral Resistance
Trussing
Rigid Frame
Shear Wall
Analysis
Quantity Take-Off
Compare Schemes
End
Independant Sub-Programs
Design Loads
Member Self Weight Estimating
2-D Analysis
Member Design Spreadsheets

Criteria

Start

Use Criteria Menu

Project

Project Data

Project Name:	Office Building - Scheme C
City/Installation:	Radford AAP
Country:	USA
State:	VA
County:	Pulaski
Design Load:	TM 5-809-1 1991
Building Code:	BOCA
Seismic Code:	TM 5-809-10 1991
Elevation Above Sea Level:	3300 ft
No. Of Stories:	2
Floor Area:	9504 sq ft
Occupancy:	Use Group B
Type Const:	3A
Seismic Lateral Load Resistance	
N-S System:	Blank
E-W System:	Blank

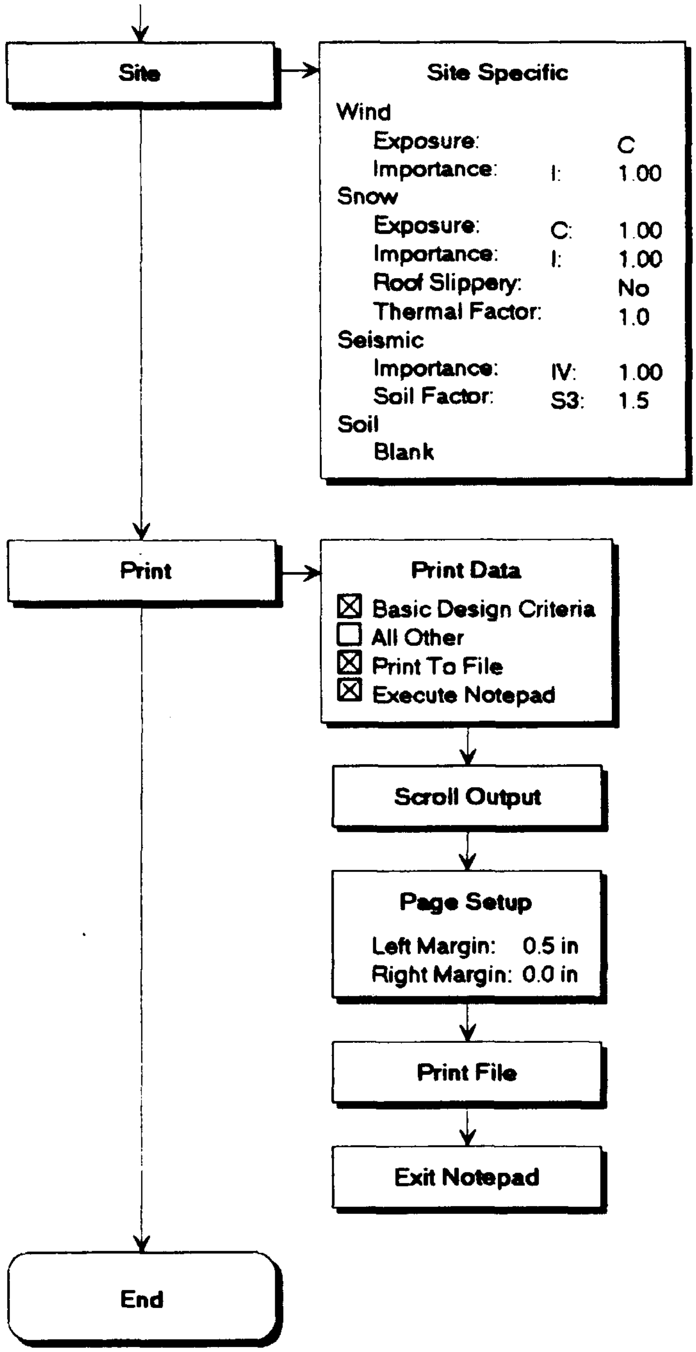
City/Installation

Select Radford AAP From List

Regional

Review Regional Data

Wind		
Basic Wind Speed:		70.0 mph
Coastal:		No
Maximum Wind Speed:		58.0 mph
Wind Direction:		SE
Snow		
Ground Snow Load:		25.0 psf
Maximum Snow Depth:		15.0 in
Snow Density:		17.3 pcf
Rain		
Average Annual Rainfall:		44.0 in
Maximum Rainfall:		4.0 in
Temperature		
Maximum temperature:		92 °F
Minimum Temperature:		-24 °F
Seismic Zone:	2A:	0.150
Frost Depth:		22 in


Site
Site Specific
Wind
Exposure: C
Importance: I: 1.00
Snow
Exposure: C: 1.00
Importance: I: 1.00
Roof Slippery: No
Thermal Factor: 1.0
Seismic
Importance: IV: 1.00
Soil Factor: S3: 1.5
Soil
Blank
Print
Print Data
☒ Basic Design Criteria
☐ All Other
☒ Print To File
☒ Execute Notepad
Scroll Output
Page Setup
Left Margin: 0.5 in
Right Margin: 0.0 in
Print File
Exit Notepad
End

```
Basic Design Criteria

Project Data
    Project Name              : Office Building - Scheme C
    City/Installation         : Radford AAP
    Country                   : USA
    State                     : VA
    County                    : Pulaski
    Design Load               : TM 5-809-1 1991
    Building Code             : BOCA
    Seismic Code              : TM 5-809-10 1991
    Elevation above sea level :   3300 ft.
    No. of Stories            :      2
    Floor Area                :   9504 sqft.
    Occupancy                 : Use Group B
    Type of Construction      : 3A
    Seismic Lateral Load Resistance
      N-S System              :
      N-S Rw                  :      0
      E-W System              :
      E-W Rw                  :      0

Regional Data
  Wind
    Basic Wind Speed          :   70.0 mph
    Coastal                   :     No
    Maximum Wind Speed        :   58.0 mph
    Wind Direction            :     SE
  Snow
    Ground Snow Load          :   25.0 psf
    Maximum Snow Depth        :   15.0 in.
    Snow Density              :   17.3 pcf
  Rain
    Average Annual Rainfall   :   44.0 in.
    Maximum Rainfall          :    4.0 in.
  Temperature
    Maximum Temperature       :   92.0 deg F
    Minimum Temperature       :  -24.0 deg F
  Seismic Zone  : 2A          :  0.150
  Frost Depth                 :     22 in.

Site Specific Data
  Wind
    Exposure                  :      C
    Importance  : I           :   1.00
  Snow
    Exposure    : C           :   1.00
    Importance  : I           :   1.00
    Roof Smooth               :     No
    Thermal Factor            :    1.0
  Seismic
    Importance  : IV          :   1.00
    Soil Factor : S3          :    1.5

Notes
  Importance Factor for Snow and Wind:
    I   All buildings and structures except those listed below.
    II  Buildings and structures where primary occupancy is one in which
        more than 300 people congregate in one area.
    III Buildings and structures designated as essential facilities,
        including, but not limited to:
          Hospital and other medical facilities having surgery or emergency
          treatment areas.
          Fire or rescue and police stations.
          Primary communication facilities and disaster operation centers.
          Power stations and other utilities required in an emergency.
          Structures having critical national defense capabilities.
```

IV Buildings and structures that represent a low hazard to human life in the event of failure, such as agricultural buildings, certain temporary facilities, and minor storage facilities.

Wind Exposure Category:

Exposure C:

Open terrain with scattered obstructions having heights generally less than 30 ft.

Snow Exposure Category:

Exposure C:

Locations in which snow removal by wind cannot be relied on to reduce roof loads because of terrain, higher structures, or several trees nearby.

* The conditions discussed should be representative of those that are likely to exist during the life of the structure. Roofs that contain several large pieces of mechanical equipment or other obstructions do not qualify for siting category A.

Snow Thermal Factor:

Heated Structure.

* These conditions should be representative of those that are likely to exist during the life of the structure.

Importance Factor for Seismic:

I. Essential Facilities

Hospitals and other medical facilities having surgury and emergency treatment areas.

Fire and police stations.

Tanks or other structures containing, housing or supporting water or other fire-suppression materials or equipment required for the protection of essential or hazardous facilities, or special occupancy structures.

Emergency vehicle shelters and garages.

Structures and equipment in emergency preparedness centers.

Stand-by power generating equipment for essential facilities.

Structures and equipment in communication centers and other facilities required for emergency response.

II. Hazardous Facilities

Structures housing, supporting or containing sufficient quantities of toxic or explosive substances to be dangerous to the safety of the general public if released.

III. Special Occupancy Structure

Covered structures whose primary occupancy is public assembly - capacity more than 300 persons.

Buildings for schools (through secondary) or day-care centers - capacity more than 250 students.

Buildings for colleges or adult education schools - capacity more than 500 students.

Medical facilities with 50 or more resident incapacitated patients, but not included above.

Jails and detention facilities.

All structures with occupancy more than 5000 persons.

Structures and equipment in power generating stations and other public utility facilities not included above, and required for

IV. Standard Occupancy Structure

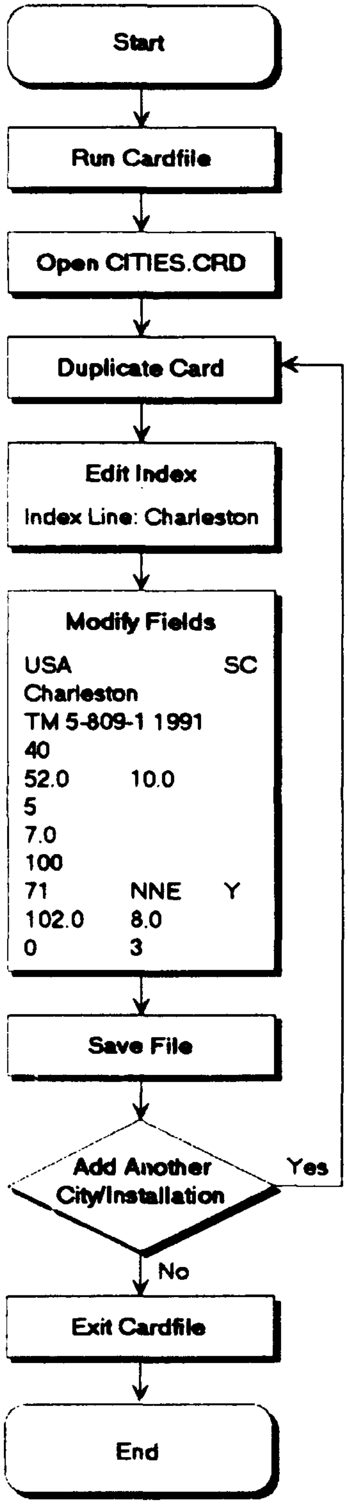
All Structures having occupancies or functions not listed above.

Seismic Soil Factor:

S3: A soil profile 70 feet or more in depth and containing more than 20 feet of soft to medium stiff clay but not more than 40 feet of soft clay.

The site factor shall be established from properly substantiated geotechnical data. In locations where the soil properties are not known in sufficient detail to determine the soil profile type, soil profile S3 shall be used. Soil profile S4 need not be assumed unless the Building Official determines that soil profile S4 may be present at the site, or in the event that soil profile S4 is established by geotechnical data.

City/Installation Database



Fields

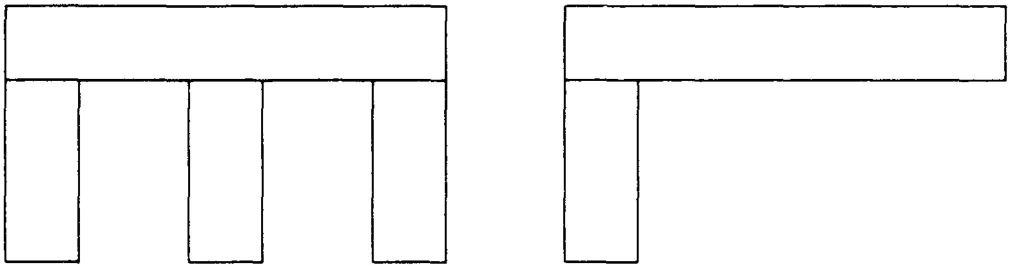
Country		State
County		
Design Load		
Elevation (ft)		
Ave. Rain (in)	Max. Rain (in)	
Ground Snow Load (psf)		
Max. Snow Depth (in)		
Basic Wind Speed (mph)		
Max. Wind Speed (mph)	Wind Direction	Coastal (Y/N)
Max. Temp. (°F)	Min. Temp. (°F)	
Frost Depth (in)	Seismic Zone	

Modeling Philosophy

A. Simplify the geometric model

For buildings with repetitive wings, only one wing needs to be modeled.

Insignificant portions such as chimneys, dormers, and small projections, should not be modeled.



Extra wings are not necessary

Simplified model

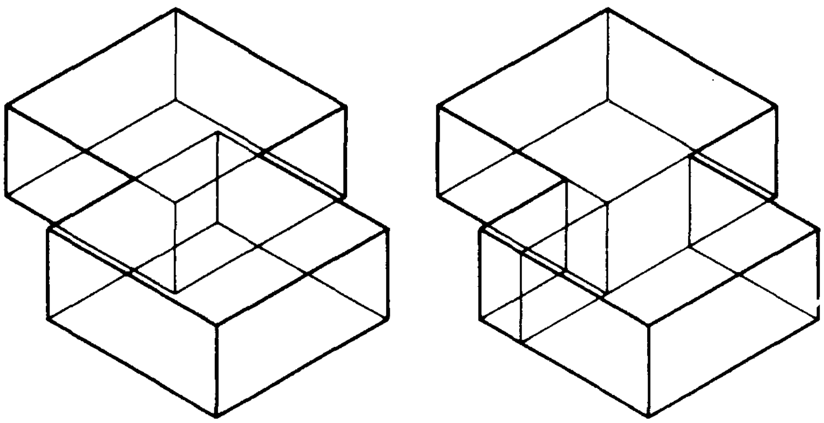
B. Make sure planes are in contact

A gap between adjoining shapes will make the surfaces exterior.

Use the Stack options to accurately place adjoining shapes.

C. Do not intersect shapes

When modeling parapet walls, make sure the corners do not intersect.



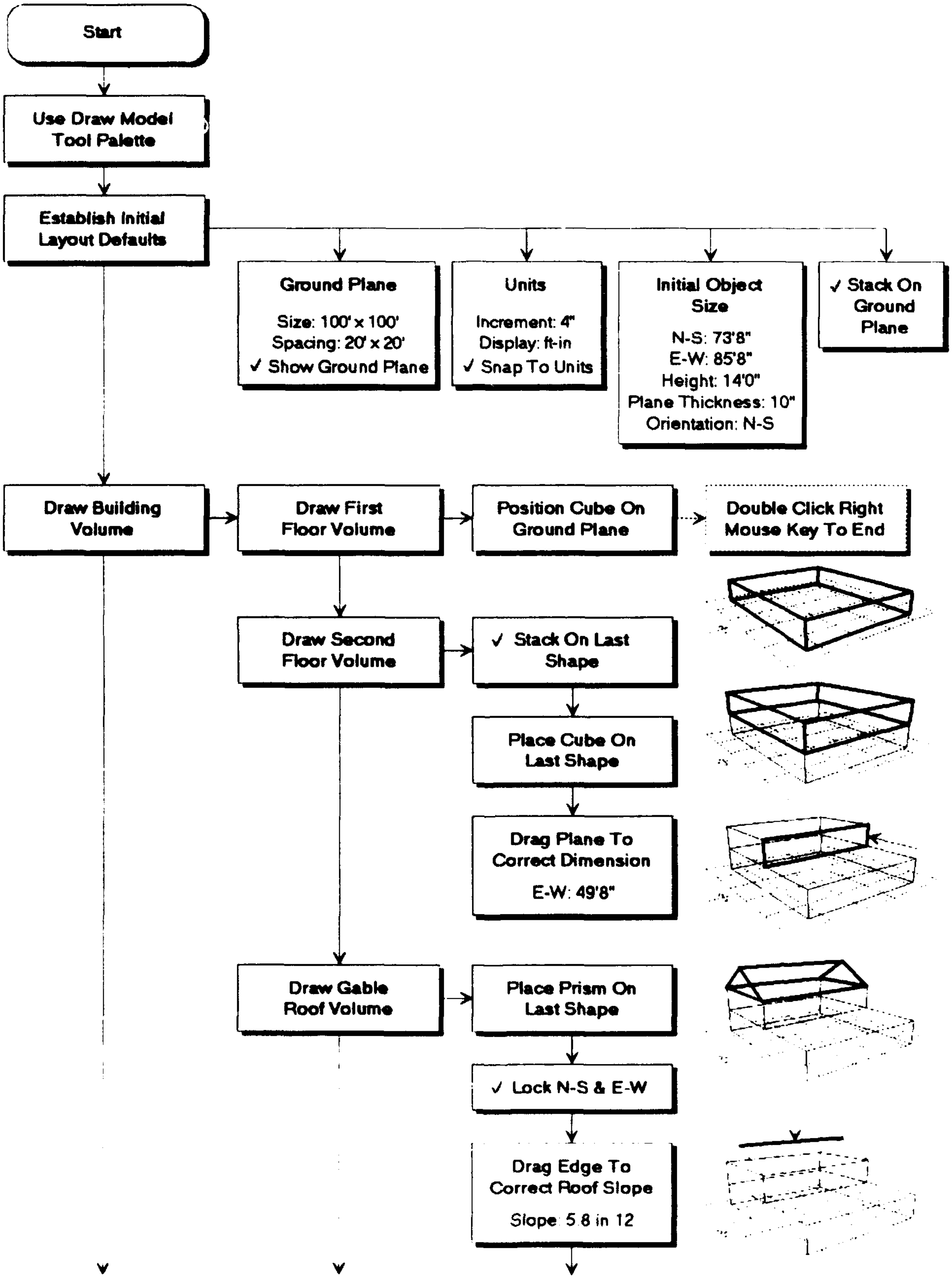
Incorrect

Correct

D. Verify the model

Use the Tape Measure command, zoom in on a plan, elevation and 3-D views to verify the model.

Draw Model



Start
Use Draw Model Tool Palette
Establish Initial Layout Defaults
Ground Plane
Size: 100' x 100'
Spacing: 20' x 20'
✓ Show Ground Plane
Units
Increment: 4"
Display: ft-in
✓ Snap To Units
Initial Object Size
N-S: 73'8"
E-W: 85'8"
Height: 14'0"
Plane Thickness: 10"
Orientation: N-S
✓ Stack On Ground Plane
Draw Building Volume
Draw First Floor Volume
Position Cube On Ground Plane
Double Click Right Mouse Key To End
Draw Second Floor Volume
✓ Stack On Last Shape
Place Cube On Last Shape
Drag Plane To Correct Dimension
E-W: 49'8"
Draw Gable Roof Volume
Place Prism On Last Shape
✓ Lock N-S & E-W
Drag Edge To Correct Roof Slope
Slope: 5.8 in 12

Draw Building Volume

Draw Gable Roof Volume

Unlock N-S & E-W

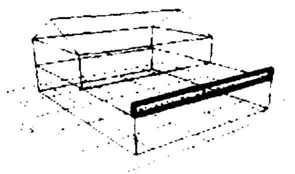
Draw Parapet Walls

Initial Object Size

Height: 4'0"

✓ Stack On Plane

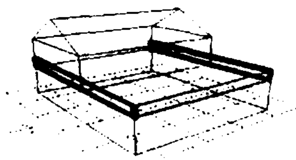
Position Vertical Plane On Roof



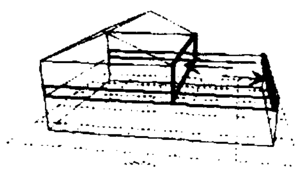
Initial Object Size

Orientation: E-W

Position Vertical Planes On Roof

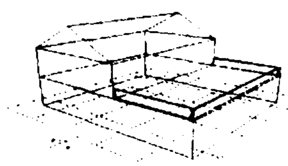


Rotate View To Select Both Slice Planes



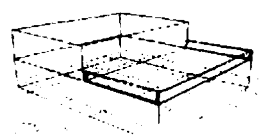
Slice Both E-W Vertical Planes

Delete 4 Unwanted Sliced Shapes



Remove Gable Roof Volume

Delete Prism Shape



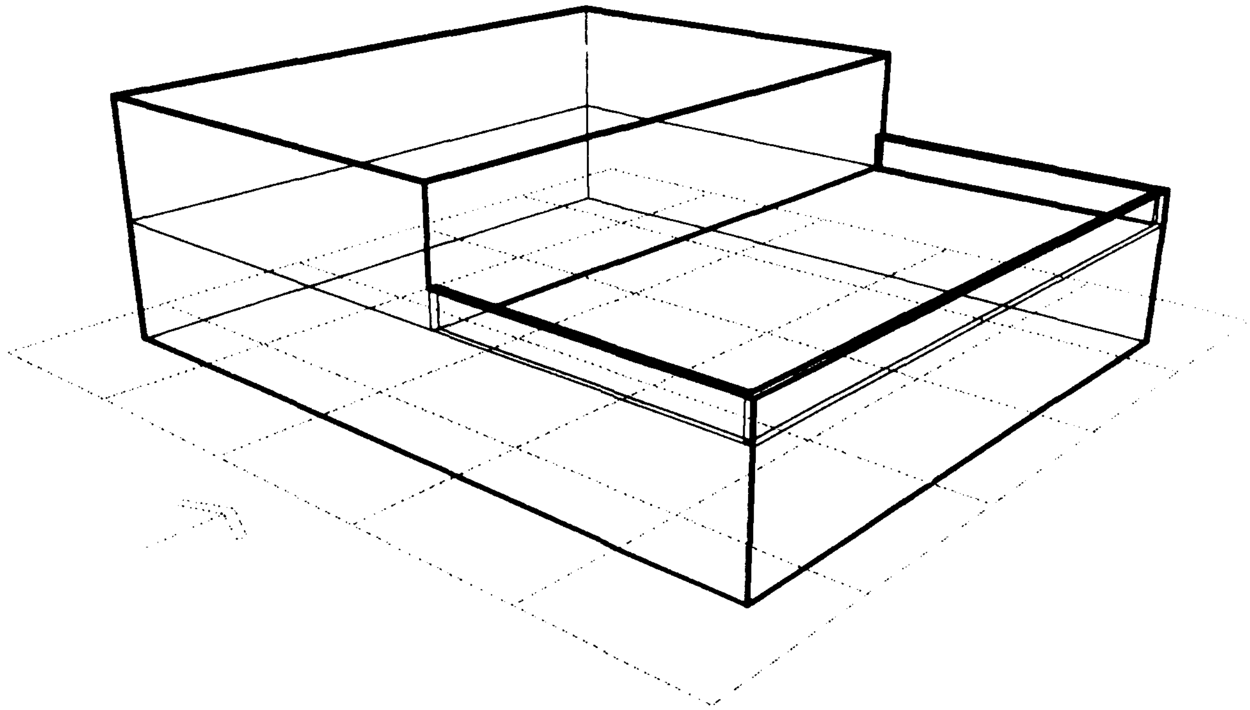
Check Building Volume

Tape Measure

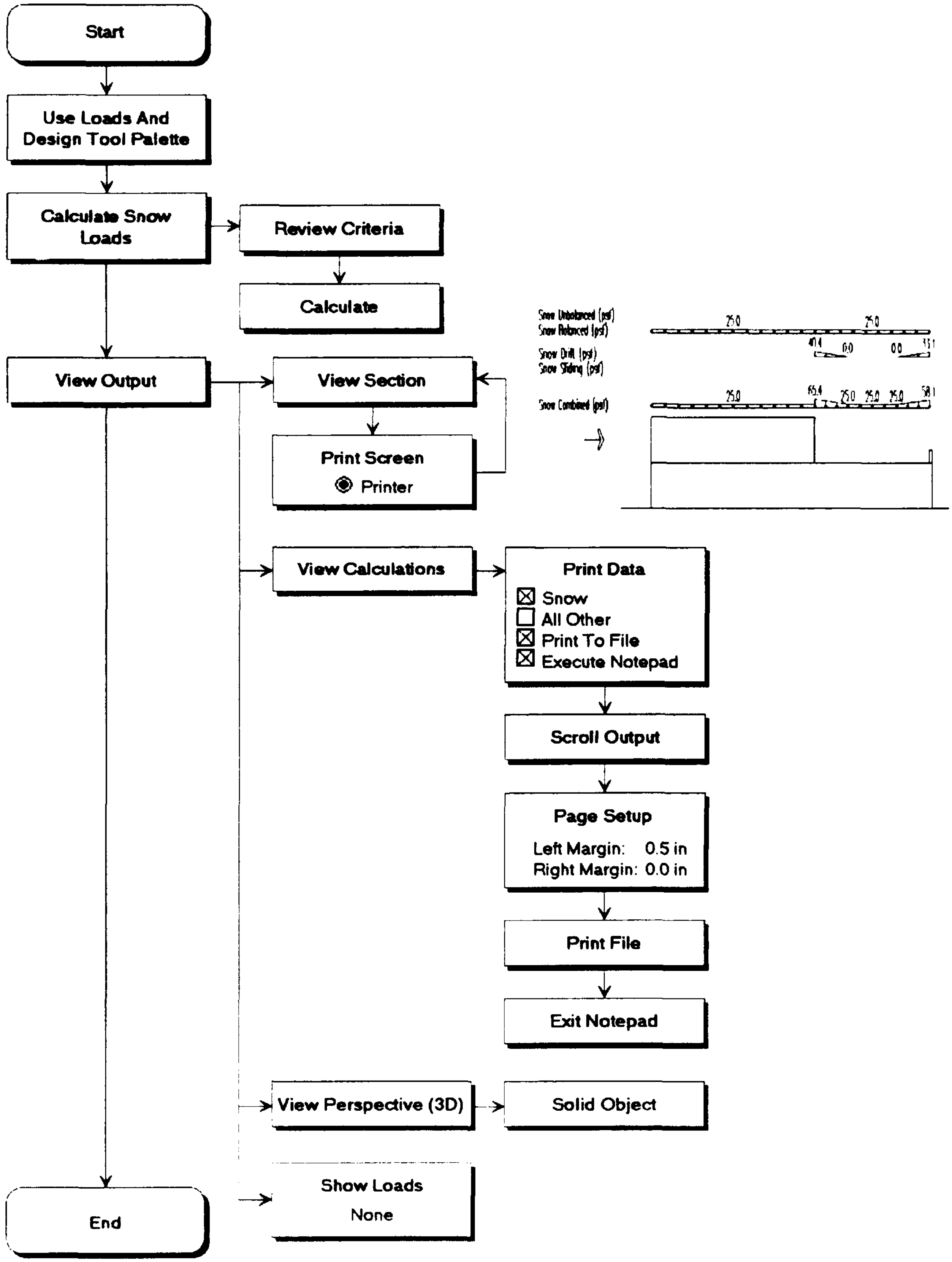
Plan, Elevation And Section

Zoom And Pan

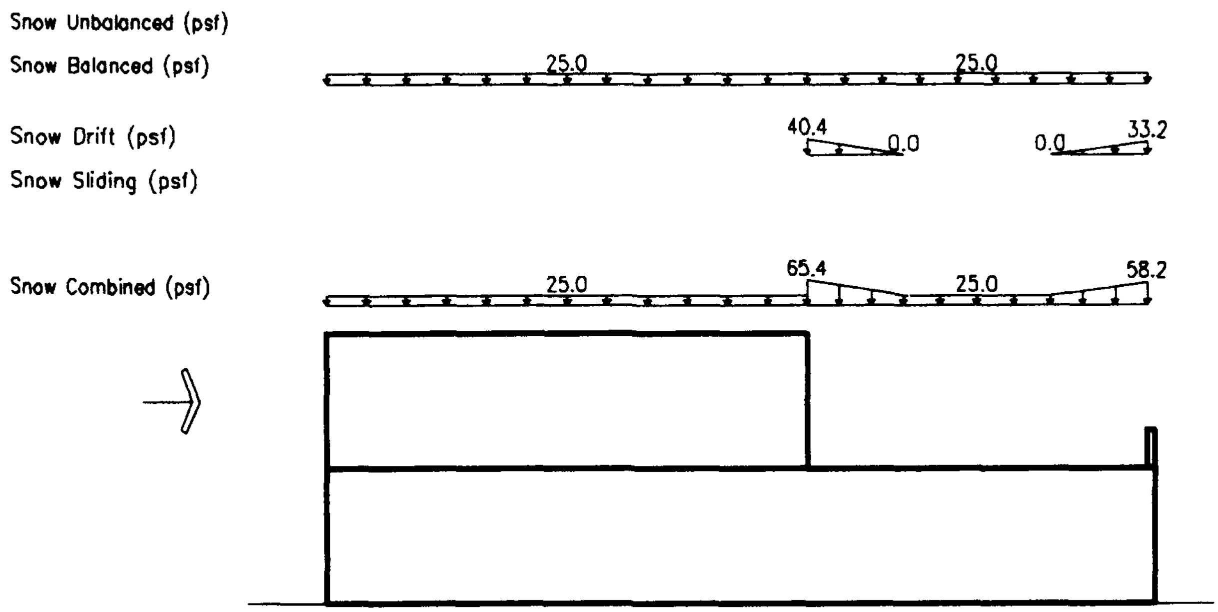
End

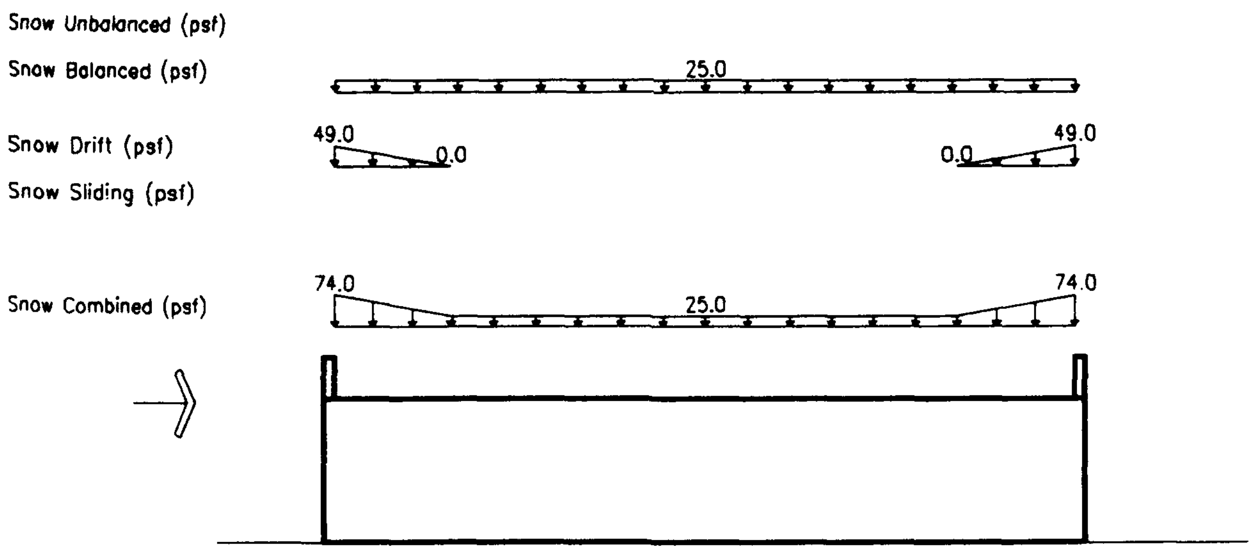


Snow Loads



Start
Use Loads And Design Tool Palette
Calculate Snow Loads
Review Criteria
Calculate
View Output
View Section
Print Screen
Printer
View Calculations
Print Data
Snow
All Other
Print To File
Execute Notepad
Scroll Output
Page Setup
Left Margin: 0.5 in
Right Margin: 0.0 in
Print File
Exit Notepad
View Perspective (3D)
Solid Object
Show Loads
None
End


Snow Unbalanced (psf)
Snow Balanced (psf)
25.0
25.0
Snow Drift (psf)
40.4
0.0
0.0
33.2
Snow Sliding (psf)
Snow Combined (psf)
25.0
65.4
25.0
58.2


Snow Unbalanced (psf)
Snow Balanced (psf)
25.0
Snow Drift (psf)
49.0
0.0
0.0
49.0
Snow Sliding (psf)
Snow Combined (psf)
74.0
25.0
74.0

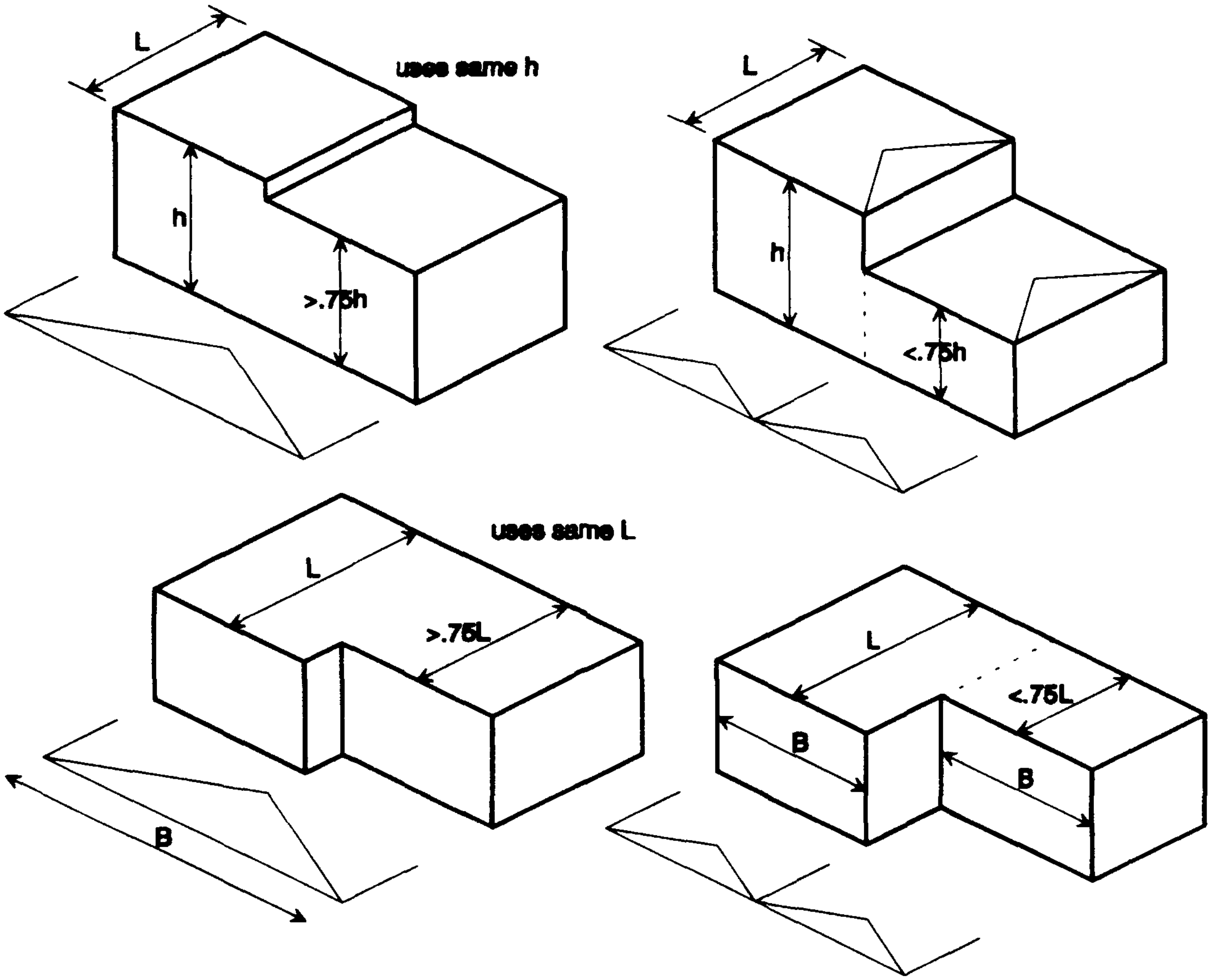
```
Project     : Office Building - Scheme C
Location    : Radford AAP
Design Load : TM 5-809-1 1991
Time        : Sat Jan 25, 1992  5:40 PM

******************* Flat/Lean-To Roof Snow Load Design *******************

Flat Roof Snow Load (Pf)
Pf = 0.7*Ce*Ct*I*Pg
Snow Exposure Category: C
Ce = 1.0
Heated Structure.
Ct = 1.0
Importance Category: I
I  = 1.0
Pg = 25.0 psf
Pf = 17.50 psf
Roof Slope: 0.00 in 12
Theta = 0 deg
Check minimum Pf where theta <= 15 deg
When Pg > 20.0 psf, min Pf = 20*I
Min Pf = 20.00 psf
Since theta < 1/2 in/ft, 5 psf rain-on-snow surcharge applies.
+-------------------------+
|     Pf = 25.00 psf      |
+-------------------------+

Sloped Roof Snow Load (Ps)
Ps = Cs*Pf
Roof Slippery: No
Cs = 1.00
+-------------------------+
|     Ps = 25.00 psf      |
+-------------------------+

************************* Drift Snow Load Design *************************

Pg = 25.0 psf
Snow Density = 17.25 pcf
Ps = 20.00 psf (rain-on-snow surcharge not included)
hb = Ps/density
hb = 1.16 ft
Projection Height = 4.00 ft
hc = height-hb
hc = 2.84 ft
hc/hb = 2.45 >= 0.20  Therefore consider drift load.
Importance Category: I
I  = 1.0
Snow Exposure Category: C
Ce = 1.0
Separation = 0.00 ft
lu = 35.17 ft
hd = 0.43*lu^1/3*(Pg+10)^1/4-1.5
hd = 1.93 ft
Width of drift: W = minimum of 4*hd or 4*hc >= 10 ft
w = 4*hd = 7.71 ft
w = 4*hc = 11.36 ft
+-------------------------+
|      W = 10.00 ft       |
+-------------------------+

hd = hd*(20-s)/20 = 1.93 ft
hd <= hc
Pd = hd*density
+-------------------------+
|     Pd = 33.23 psf      |
+-------------------------+
```

```
************************ Drift Snow Load Design ************************

Pg = 25.0 psf
Snow Density = 17.25 pcf
Ps = 20.00 psf (rain-on-snow surcharge not included)
hb = Ps/density
hb = 1.16 ft
Projection Height = 4.00 ft
hc = height-hb
hc = 2.84 ft
hc/hb = 2.45 >= 0.20  Therefore consider drift load.
Importance Category: I
I  = 1.0
Snow Exposure Category: C
Ce = 1.0
Separation = 0.00 ft
lu = 72.00 ft
hd = 0.43*lu^1/3*(Pg+10)^1/4-1.5
hd = 2.85 ft
Width of drift: W = minimum of 4*hd or 4*hc >= 10 ft
w = 4*hd = 11.40 ft
w = 4*hc = 11.36 ft
+------------------------+
|      W = 11.36 ft      |
+------------------------+

hd = hd*(20-s)/20 = 2.85 ft
hd > hc, therefore hd = hc = 2.84 ft
Pd = hd*density
+------------------------+
|     Pd = 49.00 psf     |
+------------------------+

************************ Drift Snow Load Design ************************

Pg = 25.0 psf
Snow Density = 17.25 pcf
Ps = 20.00 psf (rain-on-snow surcharge not included)
hb = Ps/density
hb = 1.16 ft
Projection Height = 14.00 ft
hc = height-hb
hc = 12.84 ft
hc/hb = 11.08 >= 0.20  Therefore consider drift load.
Importance Category: I
I  = 1.0
Snow Exposure Category: C
Ce = 1.0
Separation = 0.00 ft
lu = 49.67 ft
hd = 0.43*lu^1/3*(Pg+10)^1/4-1.5
hd = 2.34 ft
Width of drift: W = minimum of 4*hd or 4*hc >= 10 ft
w = 4*hd = 9.38 ft
w = 4*hc = 51.36 ft
+------------------------+
|      W = 10.00 ft      |
+------------------------+

hd = hd*(20-s)/20 = 2.34 ft
hd <= hc
Pd = hd*density
+------------------------+
|     Pd = 40.44 psf     |
+------------------------+
```

Wind Assumptions

Proportions For B/L & h/L

Defaults:	**Height Ratio:**	**0.75**
	Plan Ratio:	**0.75**



Building Height Maximum 60 Feet

Assumed for components and cladding

Main Wind Force Resisting Loads

Start

Use Loads And Design Tool Palette

Calculate Wind Loads

Review Criteria

% Opening Coefs: -0.25 & +0.25

◉ Main Wind Force Resistance System

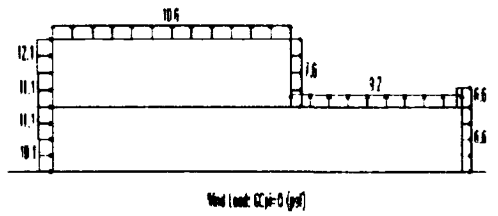
Calculate

View Output

View Section

Print Screen

◉ Printer



View Calculations

Print Data

☒ Wind
☐ All Other
☒ Print To File
☒ Execute Notepad

Scroll Output

Page Setup

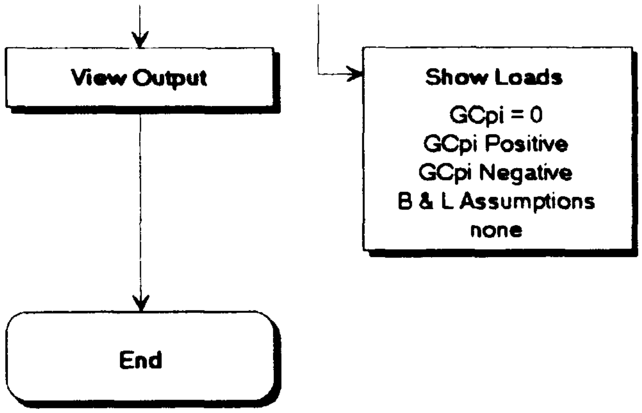
Left Margin: 0.5 in
Right Margin: 0.0 in

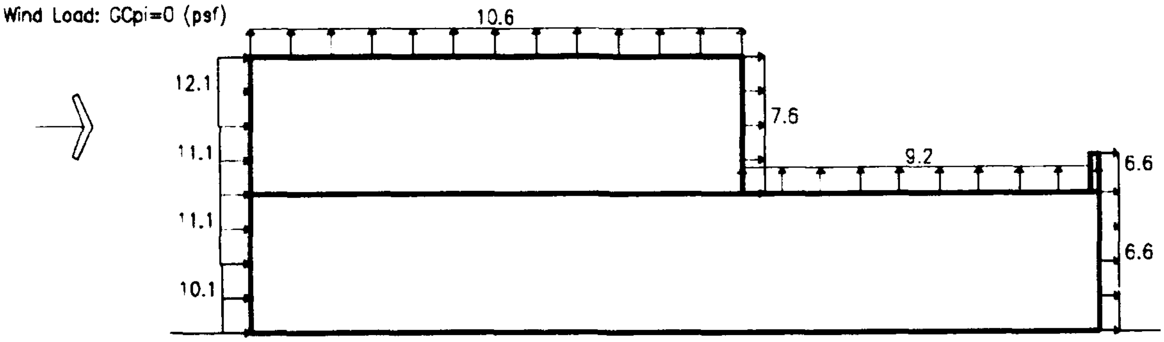
Print File

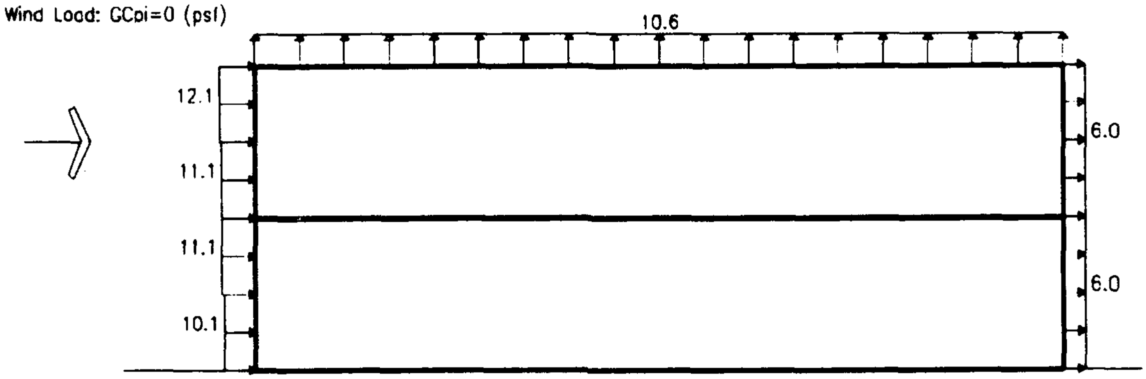
Exit Notepad

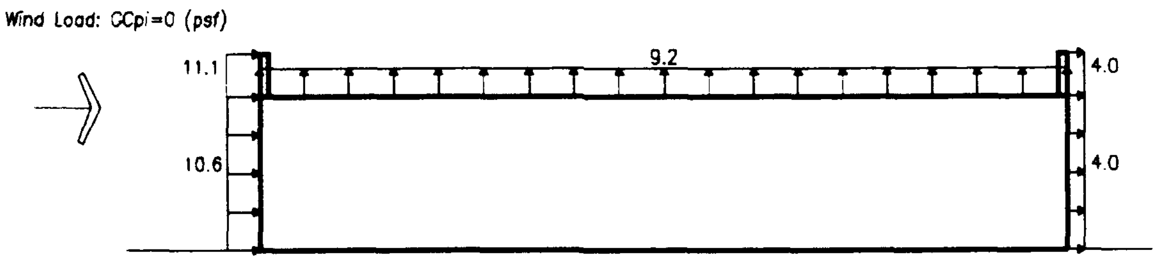
View Perspective (3D)

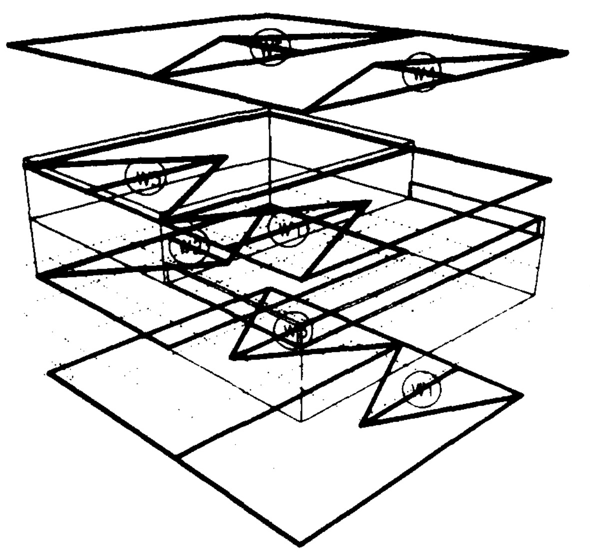
Solid Object


View Output
Show Loads
GCpi = 0
GCpi Positive
GCpi Negative
B & L Assumptions
none
End


Wind Load: GCpi=0 (psf)
10.6
12.1
11.1
11.1
10.1
7.6
9.2
6.6
6.6


Wind Load: GCpi=0 (psf)
10.6
12.1
11.1
11.1
10.1
6.0
6.0


Wind Load: GCpi=0 (psf)
9.2
11.1
10.6
4.0
4.0



Project : Office Building - Scheme C
Location : Radford AAP
Design Load : TM 5-809-1 1991
Time : Sat Jan 25, 1992 5:46 PM

****************************** Wind Load - 1 ******************************

Velocity (mph)	Importance Factor	Exposure	Width Perpend. to Wind (ft)	Length Parallel to Wind (ft)	Roof Type
70.0	1.00	C	36.0	73.7	

Distance to ocean line >= 100 mi. h/d = 0.39 <= 5

************************ Main Framing Pressures ************************

Parallel to Ridge or Length

Location	z or h (ft)	Gh	Kz	qz (psf)	Cp	External Pressure P (psf) GCpi=0	-0.25	0.25
Windward Wall								
parapet	22.0	1.32	0.89	11.2	0.80	11.8		
level 3	18.0	1.32	0.84	10.5	0.80	11.1	13.6	8.6
level 2 - 3	16.0	1.32	0.82	10.3	0.80	10.9	13.4	8.4
level 1 - 2	7.0	1.32	0.80	10.0	0.80	10.6	13.1	8.1
level 1	0.0	1.32	0.80	10.0	0.80	10.6	13.1	8.1
Leeward Wall	14.0	1.32	0.80	10.0	-0.30	-4.0	-1.5	-6.5
Side Wall	14.0	1.32	0.80	10.0	-0.70	-9.2	-6.7	-11.7
Roof	14.0	1.32	0.80	10.0	-0.70	-9.2	-6.7	-11.7
Internal	14.0		0.80	10.0		0.0	-2.5	2.5

****************************** Wind Load - 2 ******************************

Velocity (mph)	Importance Factor	Exposure	Width Perpend. to Wind (ft)	Length Parallel to Wind (ft)	Roof Type
70.0	1.00	C	73.7	49.7	

Distance to ocean line >= 100 mi. h/d = 0.56 <= 5

************************ Main Framing Pressures ************************

Parallel to Ridge or Length

Location	z or h (ft)	Gh	Kz	qz (psf)	Cp	External Pressure P (psf) GCpi=0	-0.25	0.25
Windward Wall								
level 3	28.0	1.26	0.96	12.0	0.80	12.1	15.1	9.1
level 2 - 3	21.0	1.26	0.88	11.0	0.80	11.1	14.1	8.1
level 1 - 2	7.0	1.26	0.80	10.0	0.80	10.1	13.1	7.1
level 1	0.0	1.26	0.80	10.0	0.80	10.1	13.1	7.1
Leeward Wall	28.0	1.26	0.96	12.0	-0.50	-7.6	-4.6	-10.6
Side Wall	28.0	1.26	0.96	12.0	-0.70	-10.6	-7.6	-13.6
Roof	28.0	1.26	0.96	12.0	-0.70	-10.6	-7.6	-13.6
Internal	28.0		0.96	12.0		0.0	-3.0	3.0

****************************** Wind Load - 3 ******************************

Velocity (mph)	Importance Factor	Exposure	Width Perpend. to Wind (ft)	Length Parallel to Wind (ft)	Roof Type
70.0	1.00	C	49.7	73.7	

Distance to ocean line >= 100 mi.   h/d = 0.56 <= 5

************************ Main Framing Pressures ************************

Parallel to Ridge or Length

Location	z or h (ft)	Gh	Kz	qz (psf)	Cp	External GCpi=0	Pressure P (psf) -0.25	0.25
Windward Wall								
level 3	28.0	1.26	0.96	12.0	0.80	12.1	15.1	9.1
level 2 - 3	21.0	1.26	0.88	11.0	0.80	11.1	14.1	8.1
level 1 - 2	7.0	1.26	0.80	10.0	0.80	10.1	13.1	7.1
level 1	0.0	1.26	0.80	10.0	0.80	10.1	13.1	7.1
Leeward Wall	28.0	1.26	0.96	12.0	-0.40	-6.0	-3.0	-9.0
Side Wall	28.0	1.26	0.96	12.0	-0.70	-10.6	-7.6	-13.6
Roof	28.0	1.26	0.96	12.0	-0.70	-10.6	-7.6	-13.6
Internal	28.0		0.96	12.0		0.0	-3.0	3.0

****************************** Wind Load - 4 ******************************

Velocity (mph)	Importance Factor	Exposure	Width Perpend. to Wind (ft)	Length Parallel to Wind (ft)	Roof Type
70.0	1.00	C	73.7	36.0	

Distance to ocean line >= 100 mi.   h/d = 0.39 <= 5

************************ Main Framing Pressures ************************

Parallel to Ridge or Length

Location	z or h (ft)	Gh	Kz	qz (psf)	Cp	External GCpi=0	Pressure P (psf) -0.25	0.25
Windward Wall								
parapet	22.0	1.32	0.89	11.2	0.80	11.8		
level 3	18.0	1.32	0.84	10.5	0.80	11.1	13.6	8.6
level 2 - 3	16.0	1.32	0.82	10.3	0.80	10.9	13.4	8.4
level 1 - 2	7.0	1.32	0.80	10.0	0.80	10.6	13.1	8.1
level 1	0.0	1.32	0.80	10.0	0.80	10.6	13.1	8.1
Leeward Wall	14.0	1.32	0.80	10.0	-0.50	-6.6	-4.1	-9.1
Side Wall	14.0	1.32	0.80	10.0	-0.70	-9.2	-6.7	-11.7
Roof	14.0	1.32	0.80	10.0	-0.70	-9.2	-6.7	-11.7
Internal	14.0		0.80	10.0		0.0	-2.5	2.5

****************************** Wind Load - 5 ******************************

Velocity (mph)	Importance Factor	Exposure	Width Perpend. to Wind (ft)	Length Parallel to Wind (ft)	Roof Type
70.0	1.00	C	73.7	49.7	

Distance to ocean line >= 100 mi.   h/d = 0.56 <= 5

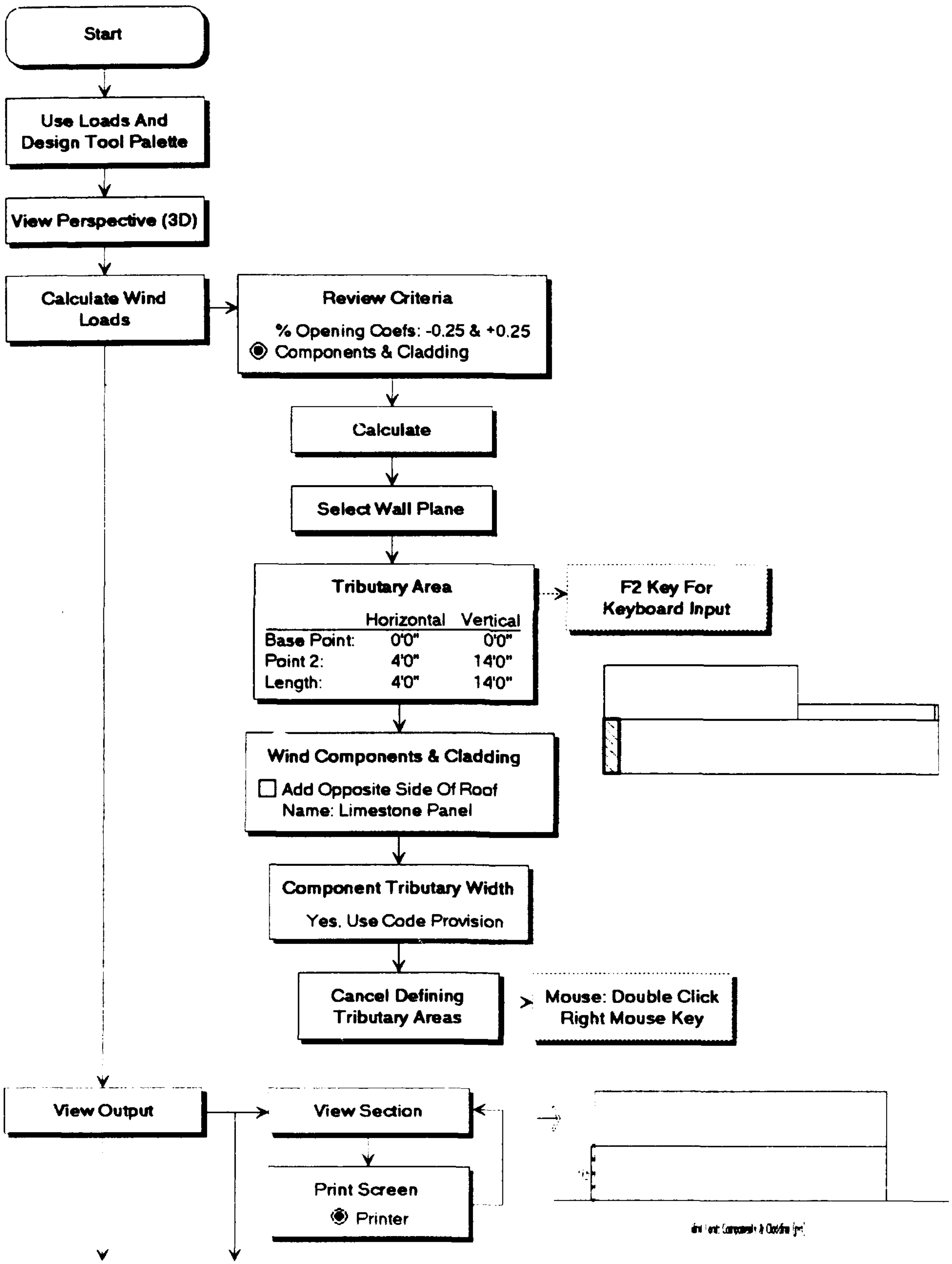
************************* Main Framing Pressures *************************

Parallel to Ridge or Length

Location	z or h (ft)	Gh	Kz	qz (psf)	Cp	External Pressure P (psf) GCpi=0	-0.25	0.25
Windward Wall								
level 2	28.0	1.26	0.96	12.0	0.80	12.1	15.1	9.1
level 1 - 2	14.0	1.26	0.80	10.0	0.80	10.1	13.1	7.1
level 1	0.0	1.26	0.80	10.0	0.80	10.1	13.1	7.1
Leeward Wall	28.0	1.26	0.96	12.0	-0.50	-7.6	-4.6	-10.6
Side Wall	28.0	1.26	0.96	12.0	-0.70	-10.6	-7.6	-13.6
Roof	28.0	1.26	0.96	12.0	-0.70	-10.6	-7.6	-13.6
Internal	28.0		0.96	12.0		0.0	-3.0	3.0

Notes for main framing:
  Positive pressures act toward surfaces.
  Pressure or suction = P = qh*Gh*Cp-qh*(GCpi)

Wind Components & Cladding Loads



View Output

View Calculations → **Print Data**

- ☒ Wind
- ☐ All Other
- ☒ Print To File
- ☒ Execute Notepad

↓

Scroll Output

↓

Page Setup

Left Margin: 0.5 in
Right Margin: 0.0 in

↓

Print File

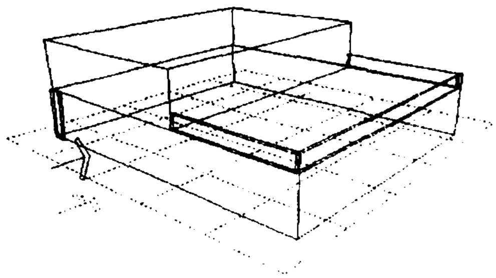
↓

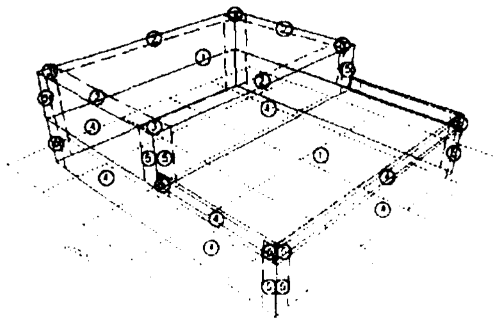
Exit Notepad

View Perspective (3D) → **Solid Object**

Show Loads

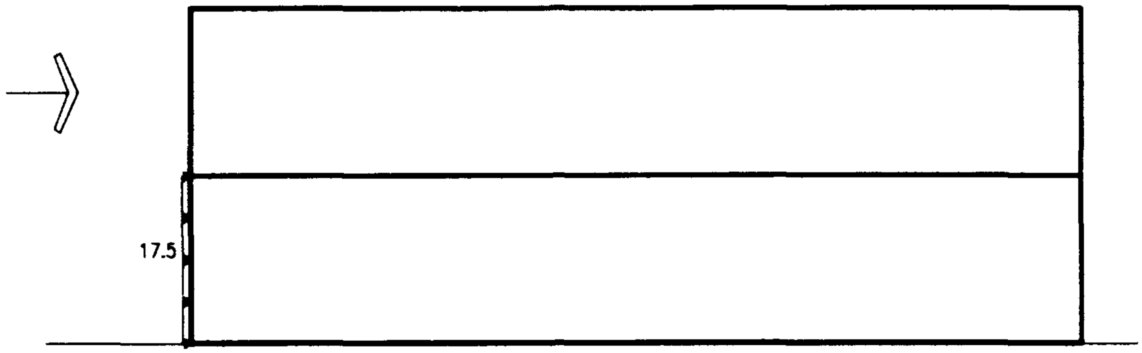
Components & Cladding
Zone Areas
none



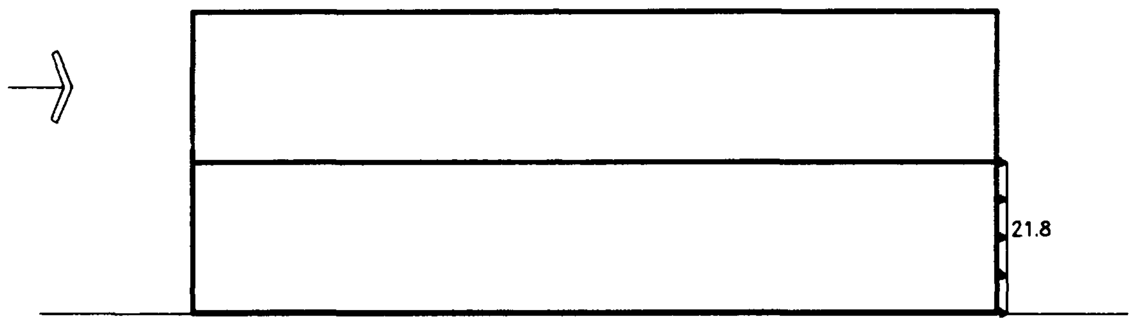


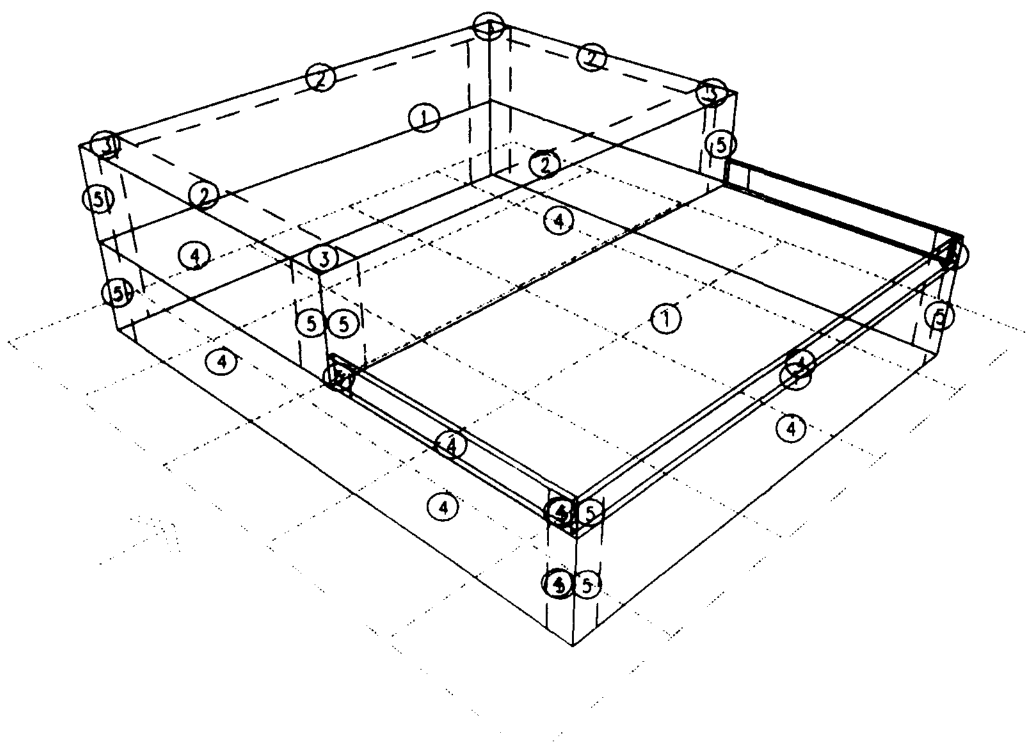
End

Wind Load: Components & Cladding (psf)



Wind Load: Components & Cladding (psf)





Wind Components & Cladding Loads

Project : Office Building - Scheme C
Location : Radford AAP
Design Load : TM 5-809-1 1991
Time : Sat Jan 25, 1992 5:49 PM

******************************* Wind Load *******************************

Velocity (mph)	Importance Factor	Exposure	Width Perpend. to Wind (ft)	Length Parallel to Wind (ft)	Roof Type
70.0	1.00	C	49.7	73.7	

Distance to ocean line >= 100 mi. h/d = 0.56 <= 5

Height (ft)	Kh	qh (psf)	GCpi	
28.0	0.96	12.0	-0.25	0.25

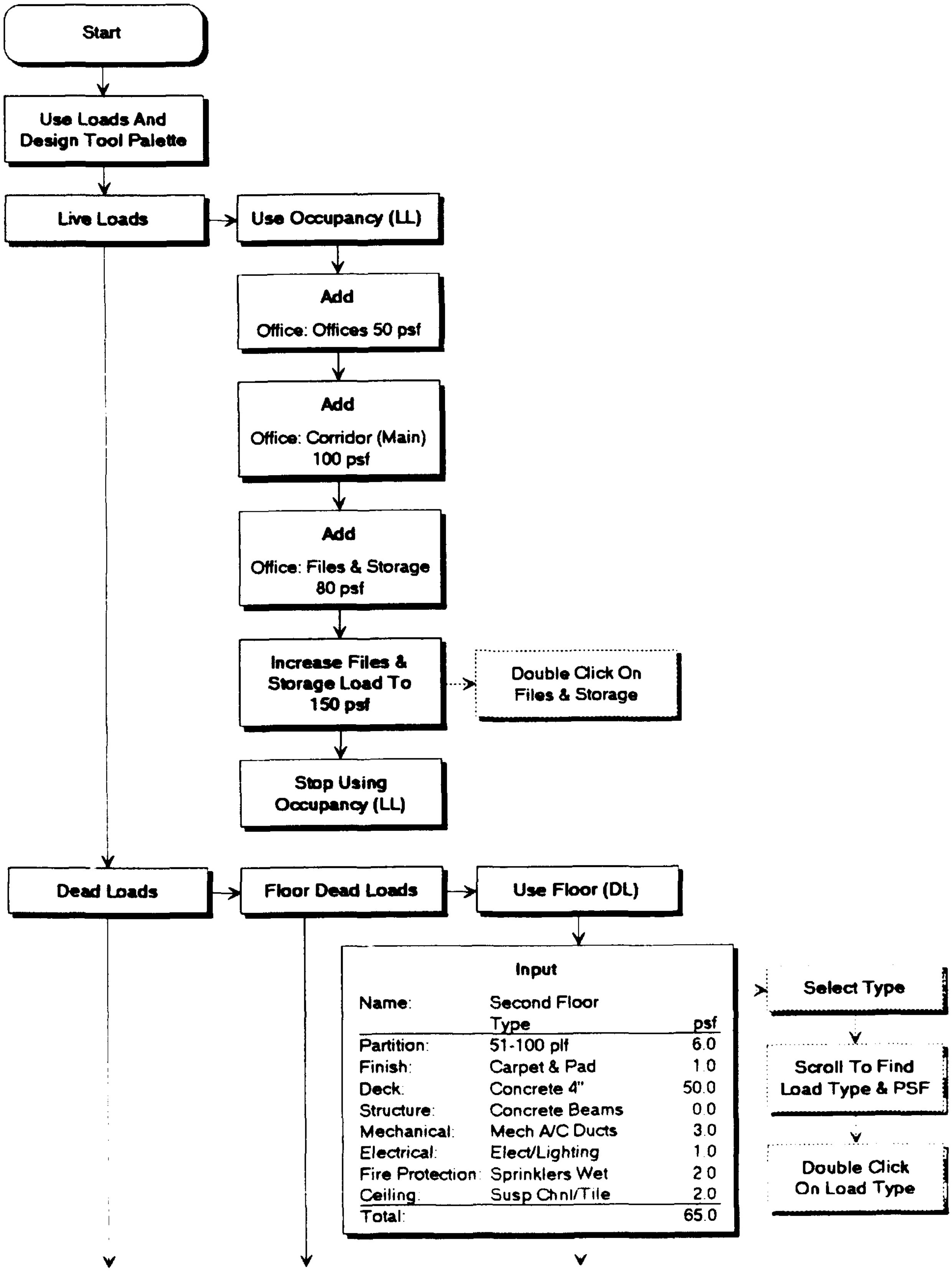
Height <= 60 ft

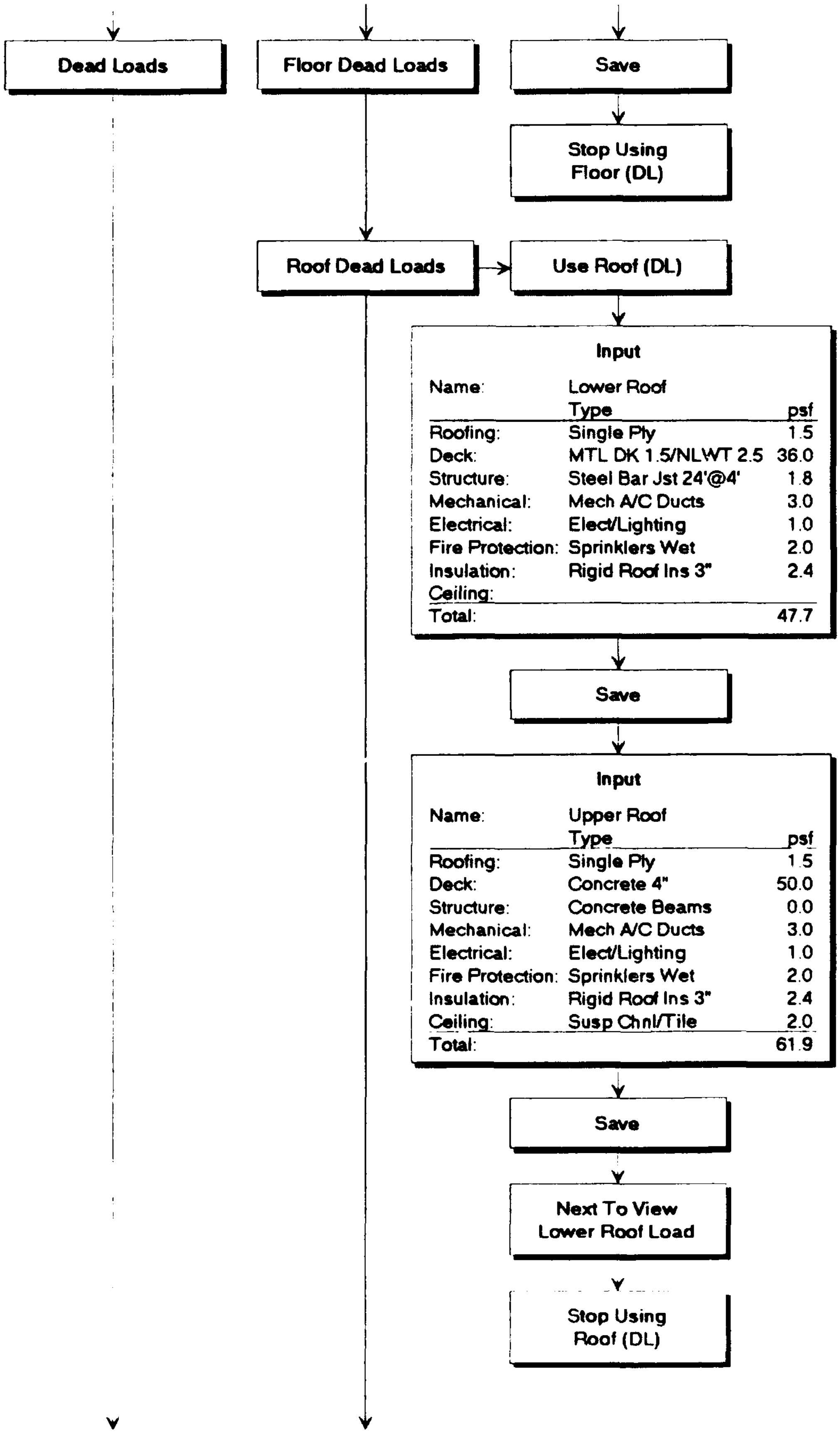
****************** Component/Cladding Pressures (psf) *******************

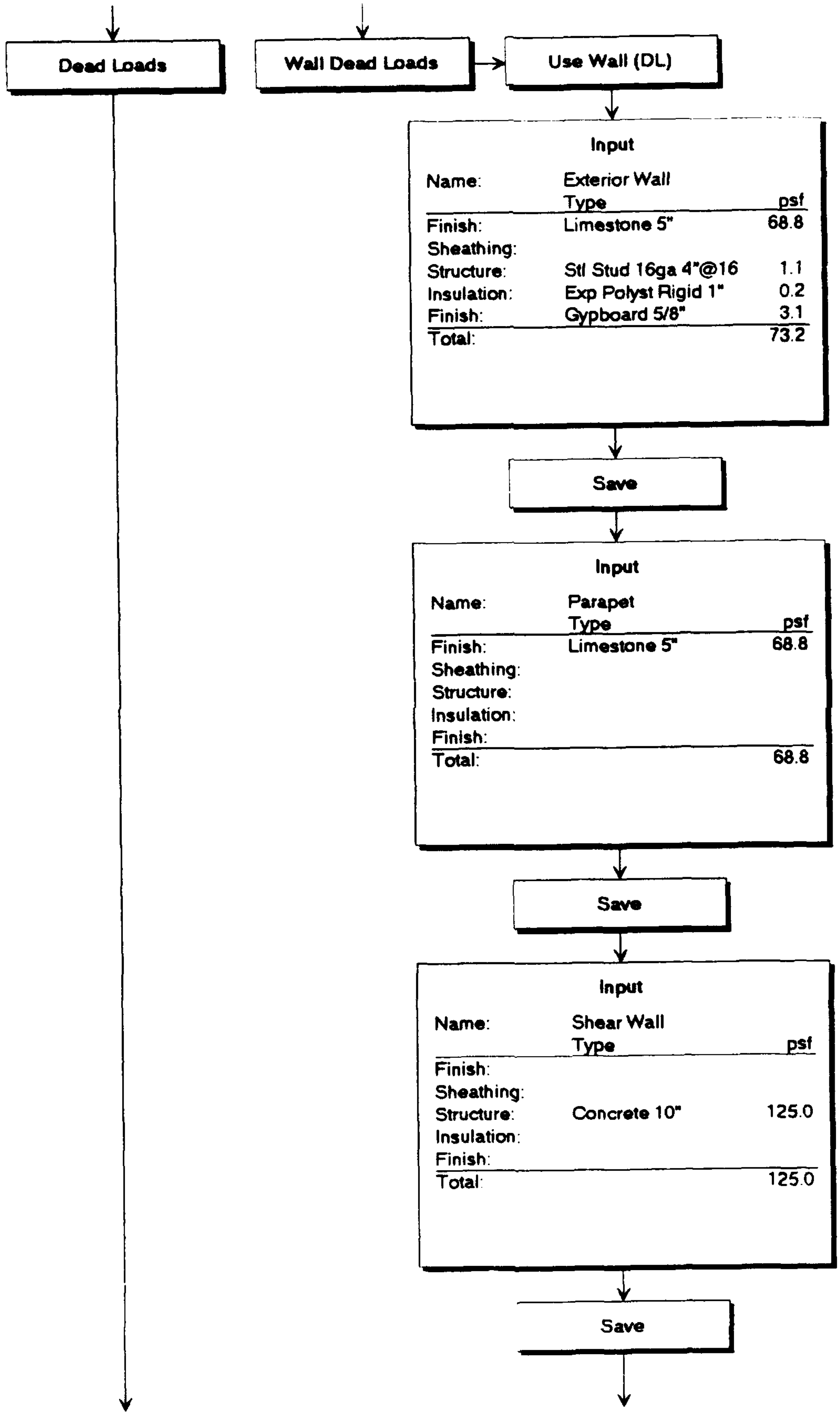
	Walls							
	Windward				Leeward			
Tributary Area (sf)	Zone 4 middles		Zone 5 corners		Zone 4 middles		Zone 5 corners	
	GCp	P	GCp	P	GCp	P	GCp	P
Internal		-3.0		-3.0		3.0		3.0
Limestone Panel 4.67 ft x 14.00 ft **								
65.3	1.21	17.5	1.21	17.5	-1.31	-18.7	-1.57	-21.8
a = 5.0 ft								

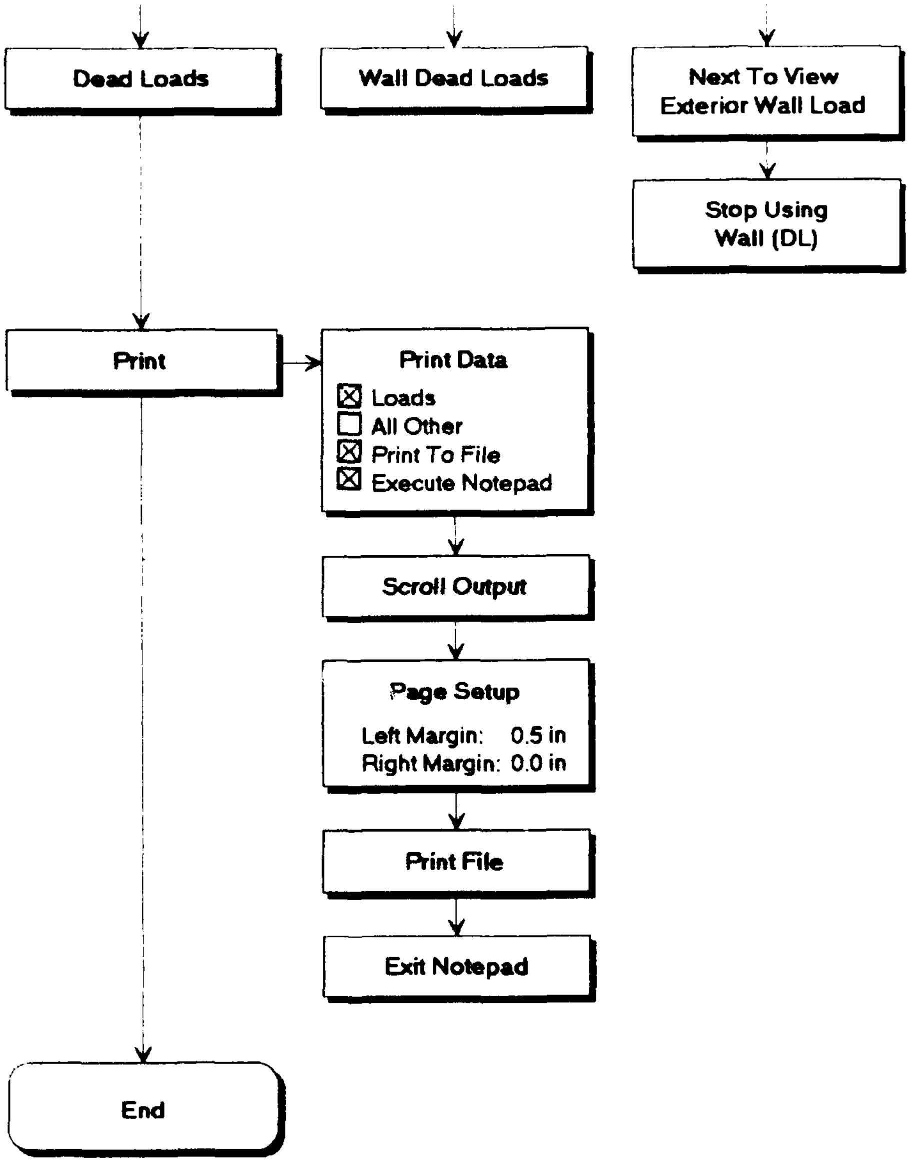
Notes for components and cladding:
P = qh(GCp)-qh(GCpi)
Internal pressures have been included in above values.
* For roof overhangs: algebraically add this pressure to the above values. P = qh(GCp) = 0.8qh
To comply with TM 5-809-1, wall external pressures have not been reduced 10% per ASCE figure 3, note 3.
** For a rectangular tributary area, the width of the area need not be less than one-third the length of the area.

Dead & Live Loads




Dead Loads
Floor Dead Loads
Save
Stop Using Floor (DL)
Roof Dead Loads
Use Roof (DL)
Input
Name: Lower Roof
Type psf
Roofing: Single Ply 1.5
Deck: MTL DK 1.5/NLWT 2.5 36.0
Structure: Steel Bar Jst 24'@4' 1.8
Mechanical: Mech A/C Ducts 3.0
Electrical: Elect/Lighting 1.0
Fire Protection: Sprinklers Wet 2.0
Insulation: Rigid Roof Ins 3" 2.4
Ceiling:
Total: 47.7
Save
Input
Name: Upper Roof
Type psf
Roofing: Single Ply 1.5
Deck: Concrete 4" 50.0
Structure: Concrete Beams 0.0
Mechanical: Mech A/C Ducts 3.0
Electrical: Elect/Lighting 1.0
Fire Protection: Sprinklers Wet 2.0
Insulation: Rigid Roof Ins 3" 2.4
Ceiling: Susp Chnl/Tile 2.0
Total: 61.9
Save
Next To View Lower Roof Load
Stop Using Roof (DL)


Dead Loads
Wall Dead Loads
Use Wall (DL)
Input
Name: Exterior Wall
Type psf
Finish: Limestone 5" 68.8
Sheathing:
Structure: Stl Stud 16ga 4"@16 1.1
Insulation: Exp Polyst Rigid 1" 0.2
Finish: Gypboard 5/8" 3.1
Total: 73.2
Save
Input
Name: Parapet
Type psf
Finish: Limestone 5" 68.8
Sheathing:
Structure:
Insulation:
Finish:
Total: 68.8
Save
Input
Name: Shear Wall
Type psf
Finish:
Sheathing:
Structure: Concrete 10" 125.0
Insulation:
Finish:
Total: 125.0
Save


Dead Loads
Wall Dead Loads
Next To View Exterior Wall Load
Stop Using Wall (DL)
Print
Print Data
Loads
All Other
Print To File
Execute Notepad
Scroll Output
Page Setup
Left Margin: 0.5 in
Right Margin: 0.0 in
Print File
Exit Notepad
End

Loads

Floor Dead Loads

Name : Second Floor

	Type	psf
Partition	: 51-100 plf	6.0
Finish	: Carpet & Pad	1.0
Deck	: Concrete NLWT 4"	50.0
Structure	: Concrete Beams	0.0
Mechanical	: Mech A/C Ducts	3.0
Electrical	: Elect/Lighting	1.0
Fire Protection	: Sprinklers Wet	2.0
Ceiling	: Susp Chnl/Tile	2.0
Total	:	65.0

Roof Dead Loads

Name : Lower Roof

	Type	psf
Roofing	: Single Ply	1.5
Deck	: MTL DK 1.5/NLWT 2.5	36.0
Structure	: Steel Bar Jst 24'@4'	1.8
Mechanical	: Mech A/C Ducts	3.0
Electrical	: Elect/Lighting	1.0
Fire Protection	: Sprinklers Wet	2.0
Insulation	: Rigid Roof Ins 3"	2.4
Ceiling	:	0.0
Total	:	47.7

Name : Upper Roof

	Type	psf
Roofing	: Single Ply	1.5
Deck	: Concrete NLWT 4"	50.0
Structure	: Concrete Beams	0.0
Mechanical	: Mech A/C Ducts	3.0
Electrical	: Elect/Lighting	1.0
Fire Protection	: Sprinklers Wet	2.0
Insulation	: Rigid Roof Ins 3"	2.4
Ceiling	: Susp Chnl/Tile	2.0
Total	:	61.9

Wall Dead Loads

Name : Exterior Wall

	Type	psf
Finish	: Limestone 5"	68.8
Sheathing	:	0.0
Structure	: Stl Stud 16ga 4"@16	1.1
Insulation	: Exp Polysty Rigid 1"	0.2
Finish	: Gypboard 5/8"	3.1
Total	:	73.2

Name : Parapet

	Type	psf
Finish	: Limestone 5"	68.8
Sheathing	:	0.0
Structure	:	0.0
Insulation	:	0.0
Finish	:	0.0
Total	:	68.8

Name : Shear Wall

	Type	psf
Finish	:	0.0
Sheathing	:	0.0
Structure	: Concrete 10"	125.0
Insulation	:	0.0
Finish	:	0.0
Total	:	125.0

Occupancy Live Loads

Name	psf
Office: Offices	50
Office: Corridor (main)	100
Office: Files & Storage	150a

a. Variable design load. Increase may be necessary.

Notes

Uniformly distributed live loads for supporting members; i.e., two-way slab, beam, girder or columns having an influence area of 400 sq ft or more may be reduced with: L = Lo*[0.25+(15/sqrt(Ai))]

The reduced design live load will not be less than 50% of the unit live load for members supporting one floor, nor less than 40% of the unit live load for members supporting two or more floors.

Exceptions: For live loads less than 100 psf, no reduction is permitted for members supporting floor(s) in the following areas:

- -public assembly
- -garages [except where 2 or more floors are supported]
- -one-way slab floor

For live loads greater than 100 psf and for garages used for passenger cars only, no reduction is permitted for members supporting one floor; however, where two or more floors are supported, a 20% reduction is permitted.

Minimum Roof Live Load

Start

Use Loads & Design Tool Palette

Select Second Floor/ Lower Roof Horizontal Structural Plane

Calculate Minimum Roof Live Load

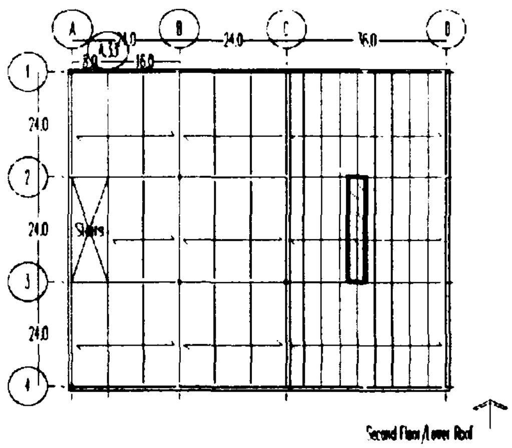
Minimum Roof (LL)

☐ Add Opposite Roof

Tributary Area

	Horizontal	Vertical
Base Point:	62'10"	24'10"
Point 2:	66'10"	48'10"
Length:	4'0"	24'0"

Cancel Minimum Roof (LL)



View Output

View Section

Print Screen

◉ Printer

View Calculations

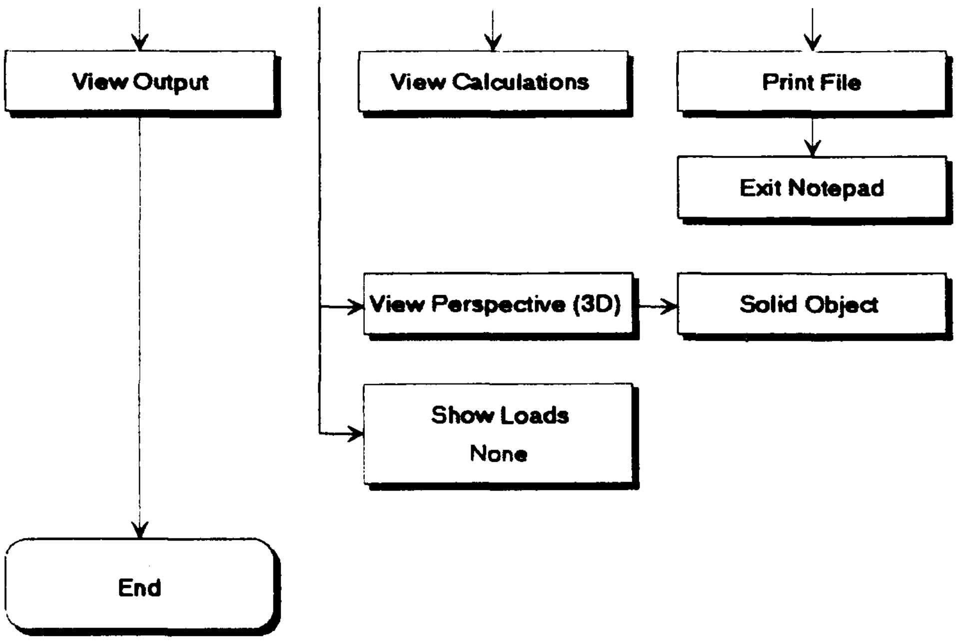
Print Data

☒ Min. Roof LL
☐ All Other
☒ Print To File
☒ Execute Notepad

Scroll Output

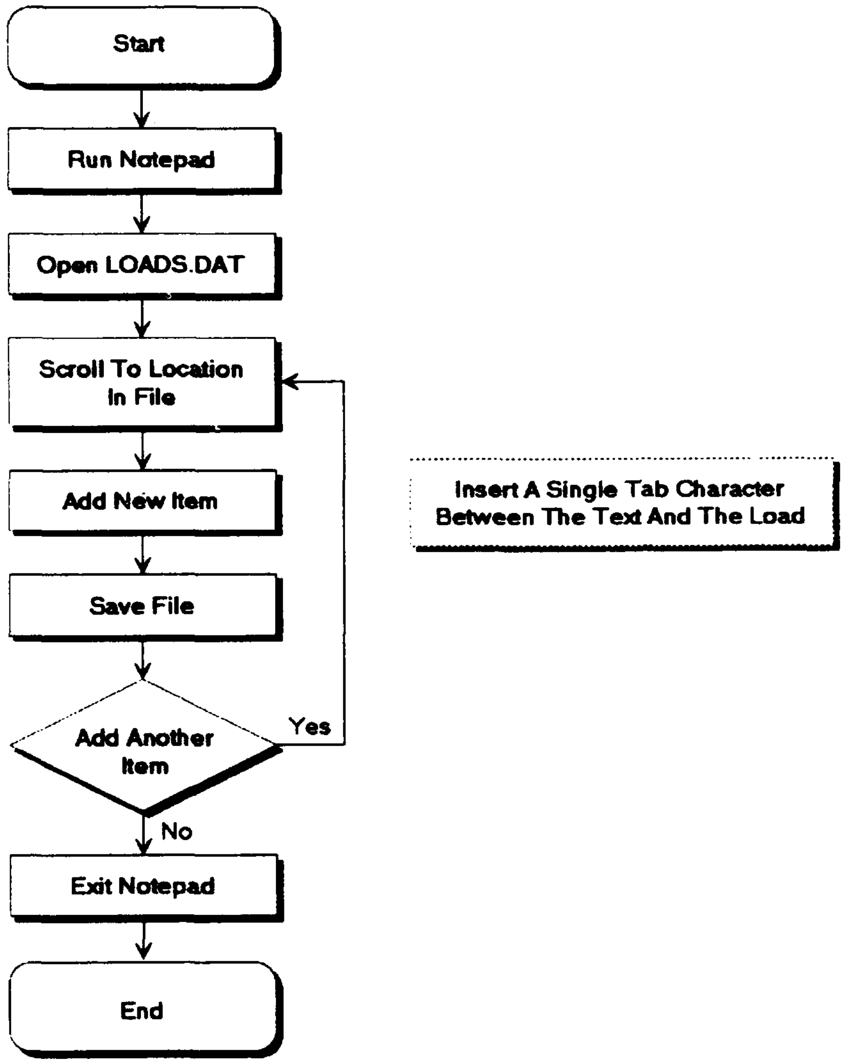
Page Setup

Left Margin: 0.5 in
Right Margin: 0.0 in


View Output
View Calculations
Print File
Exit Notepad
View Perspective (3D)
Solid Object
Show Loads
None
End

```
Project     : Office Building - Scheme C
Location    : Radford AAP
Design Load : TM 5-809-1 1991
Time        : Sat Jan 25, 1992  6:16 PM

*********************** Minimum Roof Live Load (Lr) ***********************

Tributary area (At) : 96 sf
Roof slope     (F)  : 0.00 in 12

Lr = 20*R1*R2 >= 12
At <= 200       R1 = 1.00
F <= 4          R2 = 1.00
Lr = 20.00 psf
minimum Lr = 12 psf
+------------------------+
|     Lr = 20.00 psf     |
+------------------------+
Check minimum roof live load, Lr, against minimum snow design loads.

Additionally, for the design of secondary members such as roof
decking and rafters, a concentrated live load with 250 lbs uniformly
distributed over an area of 2 feet square (4 sqft) will be included.
The concentrated load will be located so as to produce the maximum
stress in the member.
```

Loads Database



Draw Grid & Openings

Start

Use Draw Structure Tool Palette

Define Structural Grid

Select Second Floor/ Lower Roof Horizontal Structural Plane

Structural Plane Information

Name: Second Floor/Lower Roof

Close Structural Plane Information Dialog Window

Define Grid

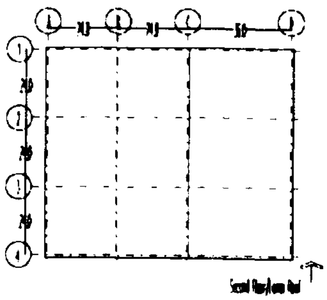
N-S Spacing:	24'0"
E-W Spacing:	24'0"
Perimeter Offset:	10"

Delete Grid Lines D & E

Delete Grid Lines

Select Grid Line E Then D

Double Click Right Mouse Key To End Deleting Grid Lines



Draw Openings

Add Opening

	Horizontal	Vertical
Base Point:	10"	24'10"
Point 2:	8'10"	48'10"
Length:	8'0"	24'0"

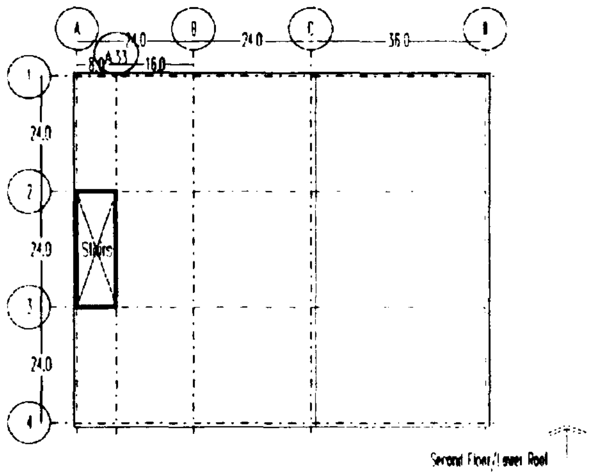
F2 Key For Keyboard Input

Opening

Name: Stairs

☐ Continuous

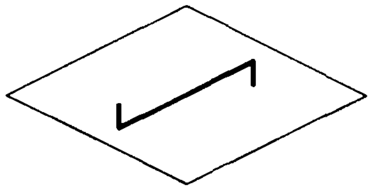
End



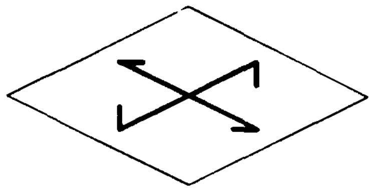
Draw Structure Philosophy

Structure Hierarchy

Surface/Deck
(horizontal)



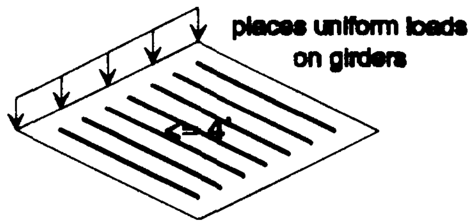
1 way



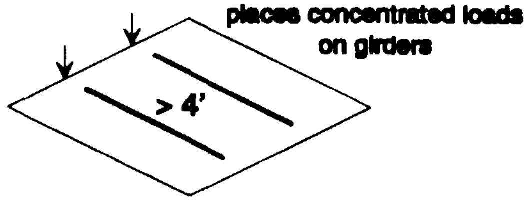
2 way
(not activated)

Linear
(horizontal)

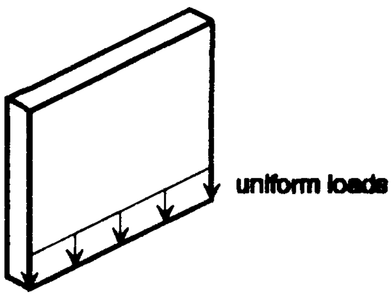
Narrowly Spaced
(joists)



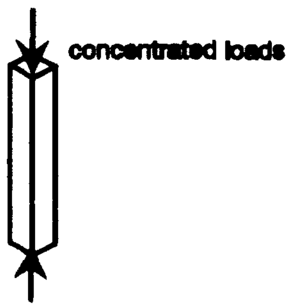
Widely Spaced
(beams)



Surface
(vertical)
(planar)



Linear
(vertical)



Draw Structure

Start

Use Draw Structure Tool Palette

Draw Upper Roof Framing

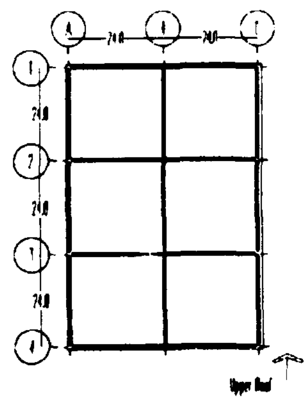
Select Upper Roof Horizontal Structural Plane

Structural Plane Information

Name: Upper Roof

Close Structural Plane Information Dialog Window

Draw Linear Beams On All Grid Lines



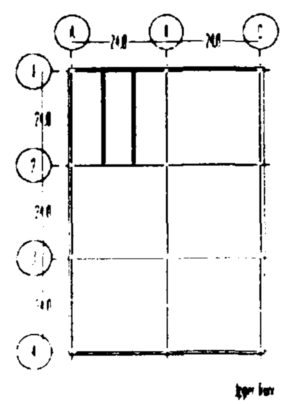
Draw Third Point Beams In Bay A1-B2

Linear: Widely Spaced

Select Handle On Grid A1-B1

Select Handle On Grid A2-B2

Double Click Right Mouse Key To End Defining Area



Save Linear Elements

Orientation: N-S

☒ Number Of Elements: 2

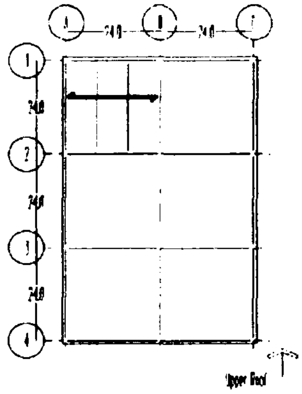
Draw One-Way Surface In Bay A1-B2

Surface: One-Way

Draw Upper Roof framing

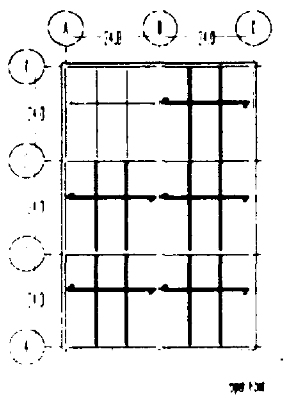
Draw Surface In Bay A1-B2

- Select Handle On Grid Line A1-A2
- Select Handle On Grid Line B1-B2
- Double Click Right Mouse Key To End Defining Area
- Save Surface Element Orientation: E-W



Copy Beams & One-Way Surface To Other Bays

- Copy Structure
- Select Third Point Beams
- Select One-Way Surface
- Double Click Right Mouse Key To End Selecting Structure
- Select Grid Location A1 As The Base Point
- Paste Structure
- Select Grid Locations B1, A2, B2, A3, B3
- Double Click Right Mouse Key To End



Draw Upper Roof framing

Delete Beams

Delete Structure

Select Beams B1-C1, C1-C2, A2-A3, B4-C4

Double Click Right Mouse Key To End

Draw Walls

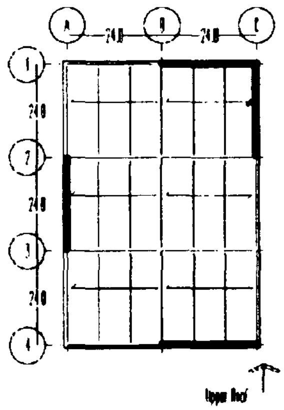
Wall 2 Grid Points

Select B1 & C1

Save Wall Elements

Orientation: E-W
Start Height: 14'
End Height: 14'
Thickness: 10"
☒ All Floors
☒ Assign Dead Load
Shear Wall

Repeat For C1-C2, A2-A3, B4-C4



Draw Columns

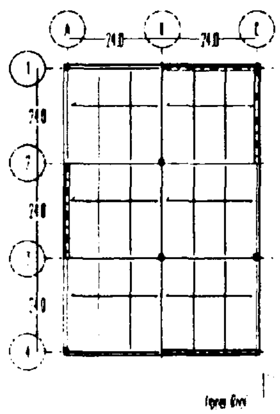
Column One Grid Intersection

Select A1, B2, B3, C3, A4

Double Click Right Mouse Key To End

Save Column Elements

Orientation: N-S
☒ All Floors



Draw Second Floor/ Lower Roof Framing

Select Second Floor/ Lower Roof Horizontal Structural Plane

Draw Linear Beams On All Grid Lines

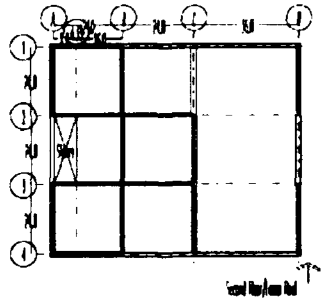
Delete Beams At Grids C2-D2,C3-D3, And Over Walls

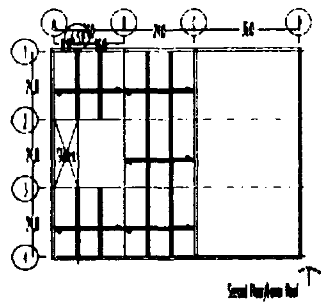
Draw Third Point Beams And One-Way Surface In Bays A1-B2, B1-C2, B2-C3, A3-B4, B3-C4

Paste Structure

Select Grid Locations A1, B1, B2, A3, B3

Double Click Right Mouse Key To End





Draw Third Point Beams In Bay A2-B3

Linear: Widely Spaced

Draw Second Floor/ Lower Roof Framing

Draw Third Point Beams In Bay A2-B3

Select Handle On Grid B2-B3

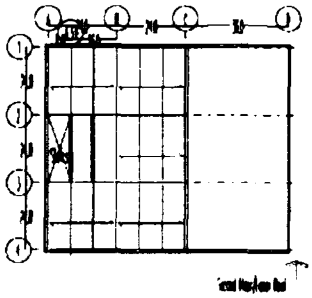
Select Handle On Grid A2-A3

Double Click Right Mouse Key To End Defining Area

Save Linear Elements

Orientation: N-S

☒ Number Of Elements: 2



Draw Surface In Bay A.33,2-B3

Surface: One-Way

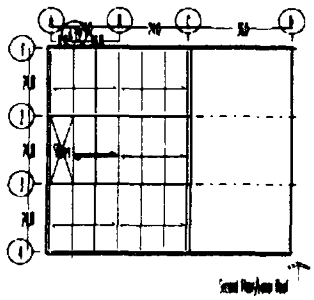
Select Handle On Grid A.33,2-A.33,3

Select Handle On Grid Line B2-B3

Double Click Right Mouse Key To End Defining Area

Save Surface Element

Orientation: E-W

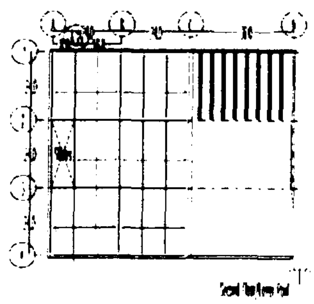


Draw Joists In Bay C1-D2

Linear: Narrowly Spaced

Select Handle On Grid C1-D1

Select Handle On Grid C2-D2



Draw Second Floor/ Lower Roof Framing

Draw Joists In Bay C1-D2

Double Click Right Mouse Key To End Defining Area

Save Linear Elements

Orientation: N-S

☒ Spacing: 48"

Draw Surface In Bay C1-D2

Surface: One-Way

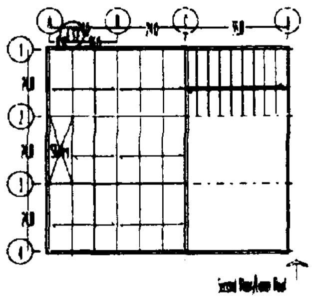
Select Handle On Grid C1-C2

Select Handle On Grid D1-D2

Double Click Right Mouse Key To End Defining Area

Save Surface Element

Orientation: E-W



Copy Joists & One-Way Surface To Other Bays

Copy Structure

Select Joists

Select One-Way Surface

Double Click Right Mouse Key To End Selecting Structure

Select Grid Location C1 As The Base Point

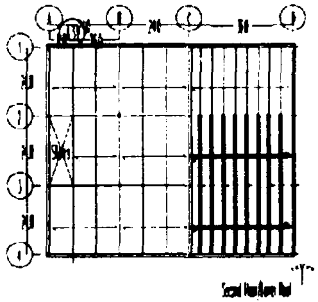
Draw Second Floor/ Lower Roof Framing

Copy Joists & One-Way Surface To Other Bays

Paste Structure

Select Grid Locations C2, C3

Double Click Right Mouse Key To End



Draw Trusses

Linear Truss-Custom

Select Grid Location C2-D2

Double Click Right Mouse Key To End Defining Area

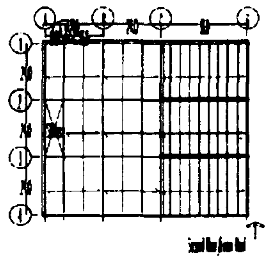
Save Linear Elements

Orientation: E-W

Truss-Custom

☐ Include Opposite Side Of Roof
Depth Of Support: 3'
Scissors Height: 0'

Repeat For Grid Location C3-D3



Draw Second Floor/ Lower Roof Framing

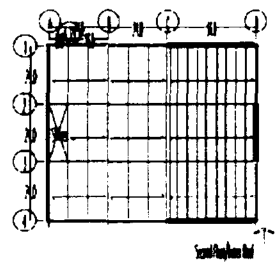
Draw Walls → Wall 2 Grid Points

Select C1 & D1

Save Wall Elements

Orientation: N-S
Start Height: 14'
End Height: 14'
Thickness: 10"
☐ All Floors
☒ Assign Dead Load
Shear Wall

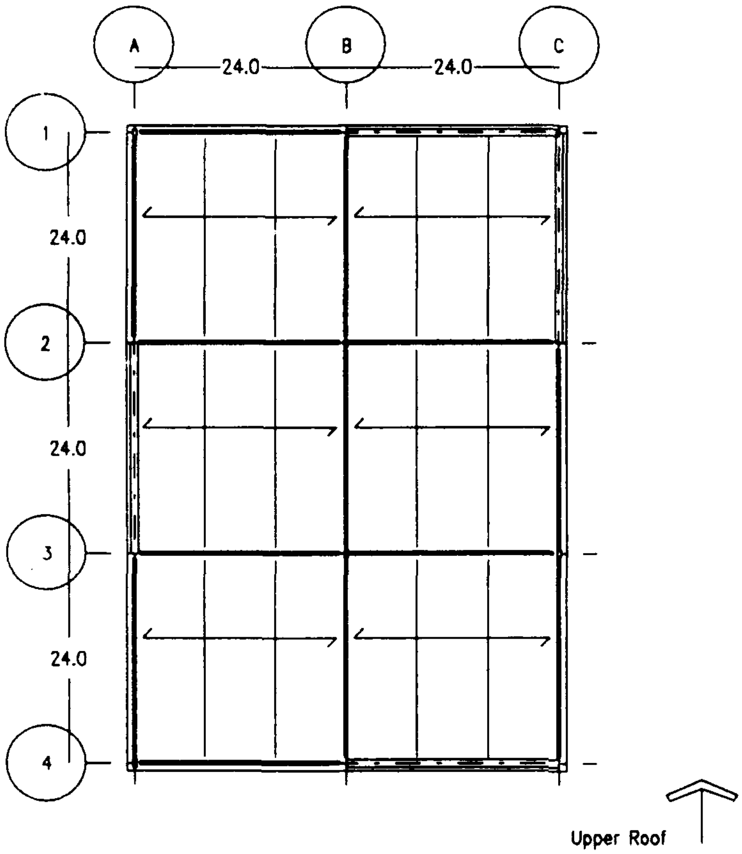
Repeat For D2-D3, C4-D4

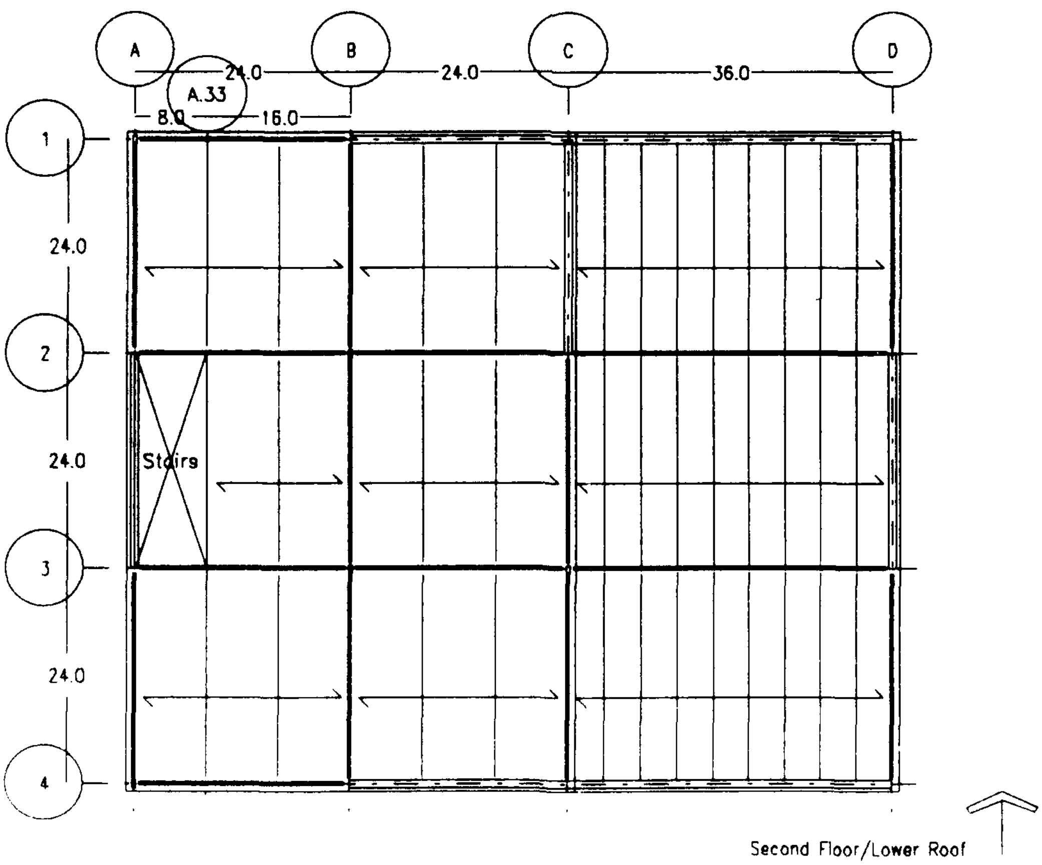


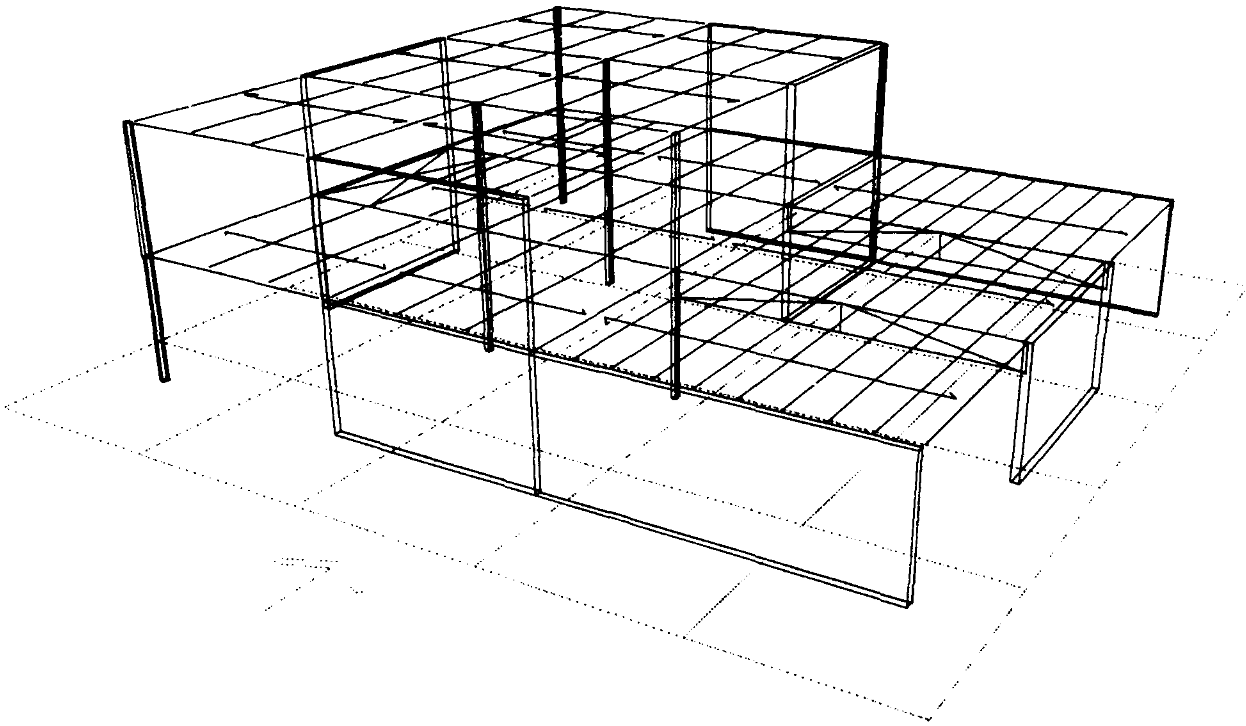
View Structure → Perspective (3D) → Transparent Object

View Structure → Show Structure

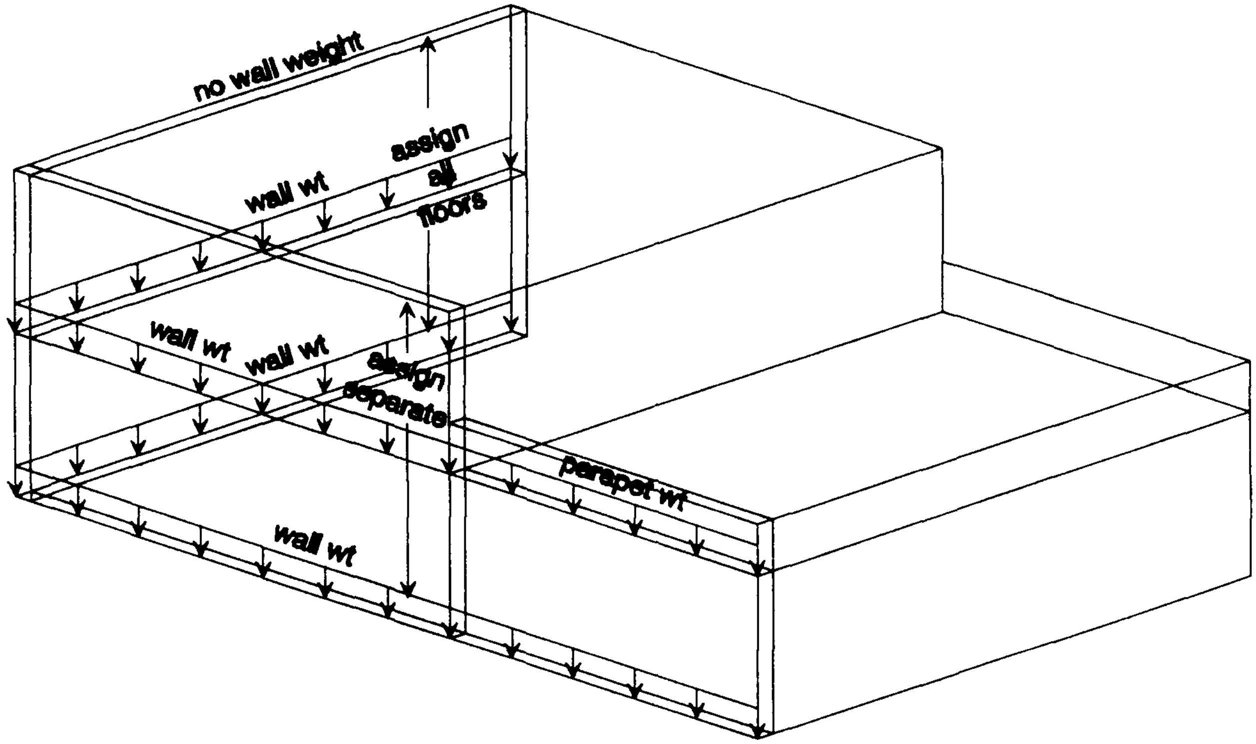
End

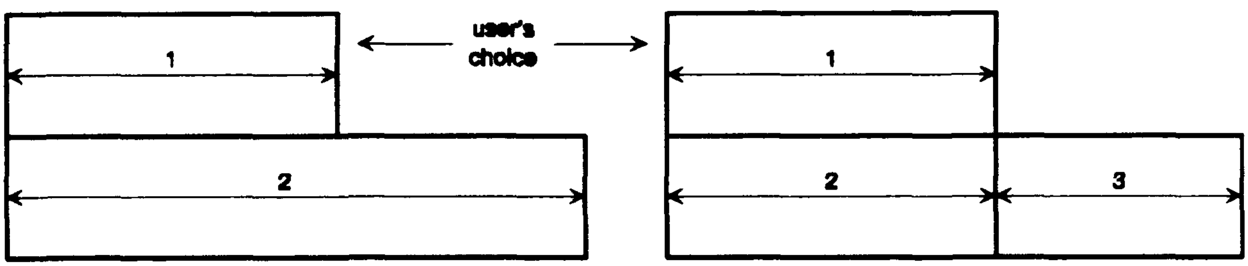

A
B
C
24.0
24.0
1
2
3
4
24.0
24.0
24.0
Upper Roof


A
B
C
D
24.0
24.0
36.0
A.33
8.0
16.0
1
2
3
4
24.0
24.0
24.0
Stairs
Second Floor/Lower Roof



Assign Wall Loads Philosophy





this appproach saves memory

Assign Loads

Start

Use Loads & Design Tool Palette

Assign Live Loads

Select Second Floor/ Lower Roof Horizontal Structural Plane

Use Occupancy (LL)

Highlight: Office 50 psf

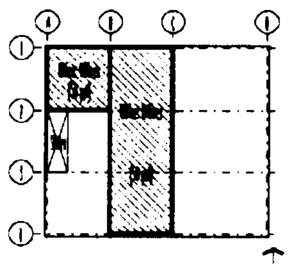
Assign Offices 50 psf

	Horizontal	Vertical
Base Point:	24'10"	10"
Point 2:	48'10"	72'10"
Length:	24'0"	72'0"

F2 Key For Keyboard Input

Assign Offices 50 psf

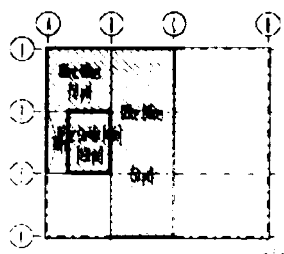
	Horizontal	Vertical
Base Point:	10"	48'10"
Point 2:	24'10"	72'10"
Length:	24'0"	24'0"



Highlight: Corridor (main) 100 psf

Assign Corrifor (main) 100 psf

	Horizontal	Vertical
Base Point:	8'10"	24'10"
Point 2:	24'10"	48'10"
Length:	16'0"	24'0"



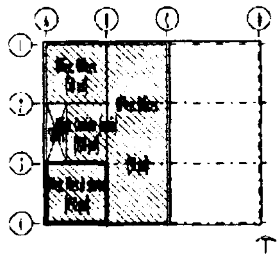
Highlight: Files & Storage 150 psf

Assign Live Loads

Assign Files & Storage 150 psf

	Horizontal	Vertical
Base Point:	10"	10"
Point 2:	24'10"	24'10"
Length:	24'0"	24'0"

Stop Using Occupancy (LL)



Assign Dead Loads

Assign Floor Loads

Use Floor (DL)

Assign Second Floor Load

	Horizontal	Vertical
Base Point:	10"	10"
Point 2:	48'10"	24'10"
Length:	48'0"	24'0"

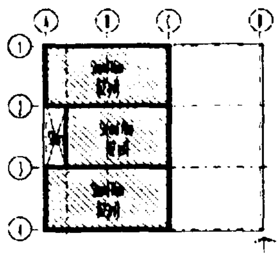
Assign Second Floor Load

	Horizontal	Vertical
Base Point:	8'10"	24'10"
Point 2:	48'10"	48'10"
Length:	40'0"	24'0"

Assign Second Floor Load

	Horizontal	Vertical
Base Point:	10"	48'10"
Point 2:	48'10"	72'10"
Length:	48'0"	24'0"

Stop Using Floor (DL)



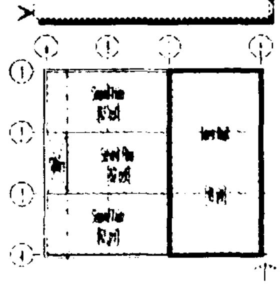
Assign Roof Loads

Use Roof (DL)

Next Button To View Lower Roof

Assign Lower Roof Load

	Horizontal	Vertical
Base Point:	48'10"	10"
Point 2:	84'10"	72'10"
Length:	36'0"	72'0"



Stop Using Roof (DL)

Assign Dead Loads

Assign Exterior Wall Loads

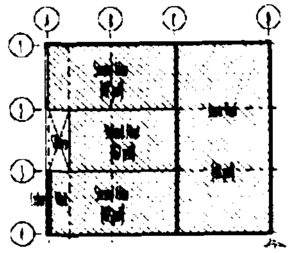
Use Wall (DL)

Assign Exterior Wall Load

☒ Assign All Floors

	Horizontal	Vertical
Base Point:	10"	10"
Point 2:	10"	24'10"
Length:	0'0"	24'0"

Next Button To View Exterior Wall



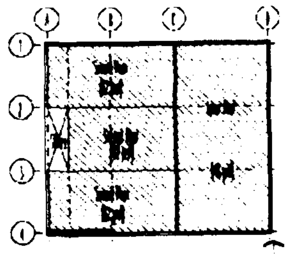
Wall Height

Start: 14'0"
End: 14'0"

Assign Exterior Wall Load

☒ Assign All Floors

	Horizontal	Vertical
Base Point:	10"	10"
Point 2:	24'10"	10"
Length:	24'0"	0'0"



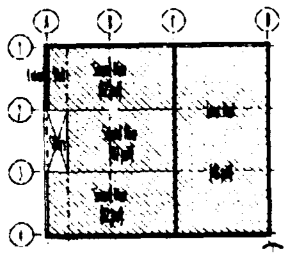
Wall Height

Start: 14'0"
End: 14'0"

Assign Exterior Wall Load

☒ Assign All Floors

	Horizontal	Vertical
Base Point:	10"	48'10"
Point 2:	10"	72'10"
Length:	0'0"	24'0"



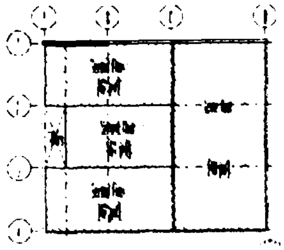
Wall Height

Start: 14'0"
End: 14'0"

Assign Exterior Wall Load

☒ Assign All Floors

	Horizontal	Vertical
Base Point:	10"	72'10"
Point 2:	24'10"	72'10"
Length:	24'0"	0'0"



Assign Dead Loads

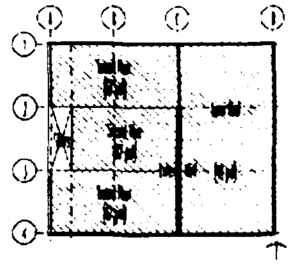
Assign Exterior Wall Loads

Wall Height
Start: 14'0"
End: 14'0"

Assign Exterior Wall Load

☐ Assign All Floors

	Horizontal	Vertical
Base Point:	48'10"	10"
Point 2:	48'10"	48'10"
Length:	0'0"	48'0"



Wall Height
Start: 14'0"
End: 14'0"

Assign Parapet Wall Loads

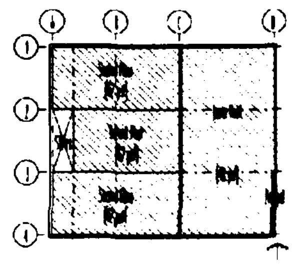
Use Wall (DL)

Assign Parapet Wall Load

☐ Assign All Floors

	Horizontal	Vertical
Base Point:	84'10"	10"
Point 2:	84'10"	24'10"
Length:	0'0"	24'0"

Next Button To View Parapet Wall

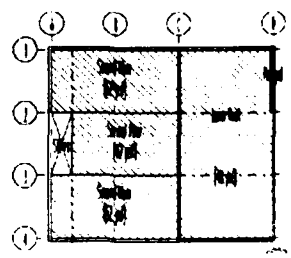


Wall Height
Start: 4'0"
End: 4'0"

Assign Parapet Wall Load

☐ Assign All Floors

	Horizontal	Vertical
Base Point:	84'10"	48'10"
Point 2:	84'10"	72'10"
Length:	0'0"	24'0"



Wall Height
Start: 4'0"
End: 4'0"

Assign Dead Loads

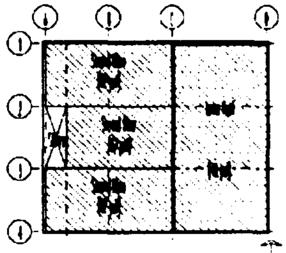
Assign Parapet Wall Loads

Assign Shear Wall Load

☐ Assign All Floors

	Horizontal	Vertical
Base Point:	48'10"	72'10"
Point 2:	84'10"	72'10"
Length:	36'0"	0'0"

Next Button To View Shear Wall



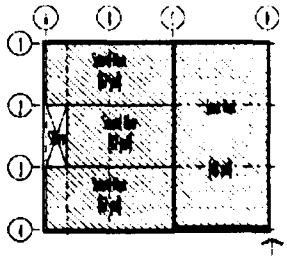
Wall Height

Start: 4'0"
End: 4'0"

Assign Shear Wall Load

☐ Assign All Floors

	Horizontal	Vertical
Base Point:	48'10"	10"
Point 2:	84'10"	10"
Length:	36'0"	0'0"



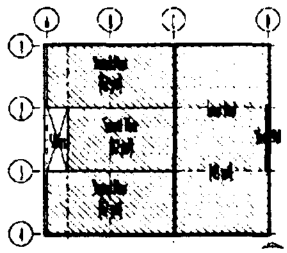
Wall Height

Start: 4'0"
End: 4'0"

Assign Shear Wall Load

☐ Assign All Floors

	Horizontal	Vertical
Base Point:	84'10"	24'10"
Point 2:	84'10"	48'10"
Length:	0'0"	24'0"



Wall Height

Start: 4'0"
End: 4'0"

Stop Using Wall (DL)

Assign Dead Loads

Assign Upper Roof Loads

Select Upper Roof Horizontal Structural Plane

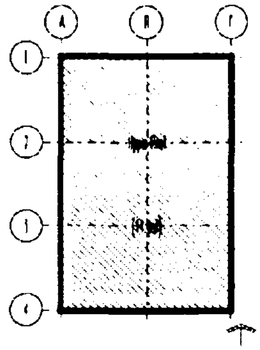
Use Roof (DL)

Assign Upper Roof Load

☐ Assign All Floors

	Horizontal	Vertical
Base Point:	10"	10"
Point 2:	48'10"	72'10"
Length:	48'0"	72'0"

Next Button To View Upper Roof



Stop Using Roof (DL)

Assign Ground Floor Wall Loads

Select Ground Floor Horizontal Structural Plane

Structural Plane Information

Name: Ground Floor

Close Structural Plane Information Dialog Window

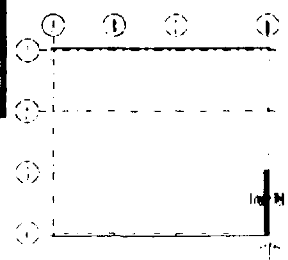
Use Wall (DL)

Assign Exterior Wall Load

☐ Assign All Floors

	Horizontal	Vertical
Base Point:	84'10"	10"
Point 2:	84'10"	24'10"
Length:	0'0"	24'0"

Next Button To View Exterior Wall



Wall Height

Start: 14'0"

End: 14'0"

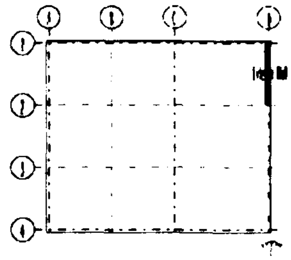
Assign Dead Loads

Assign Ground Floor Wall Loads

Assign Exterior Wall Load

☐ Assign All Floors

	Horizontal	Vertical
Base Point:	84'10"	48'10"
Point 2:	84'10"	72'10"
Length:	0'0"	24'0"



Wall Height

Start: 14'0"
End: 14'0"

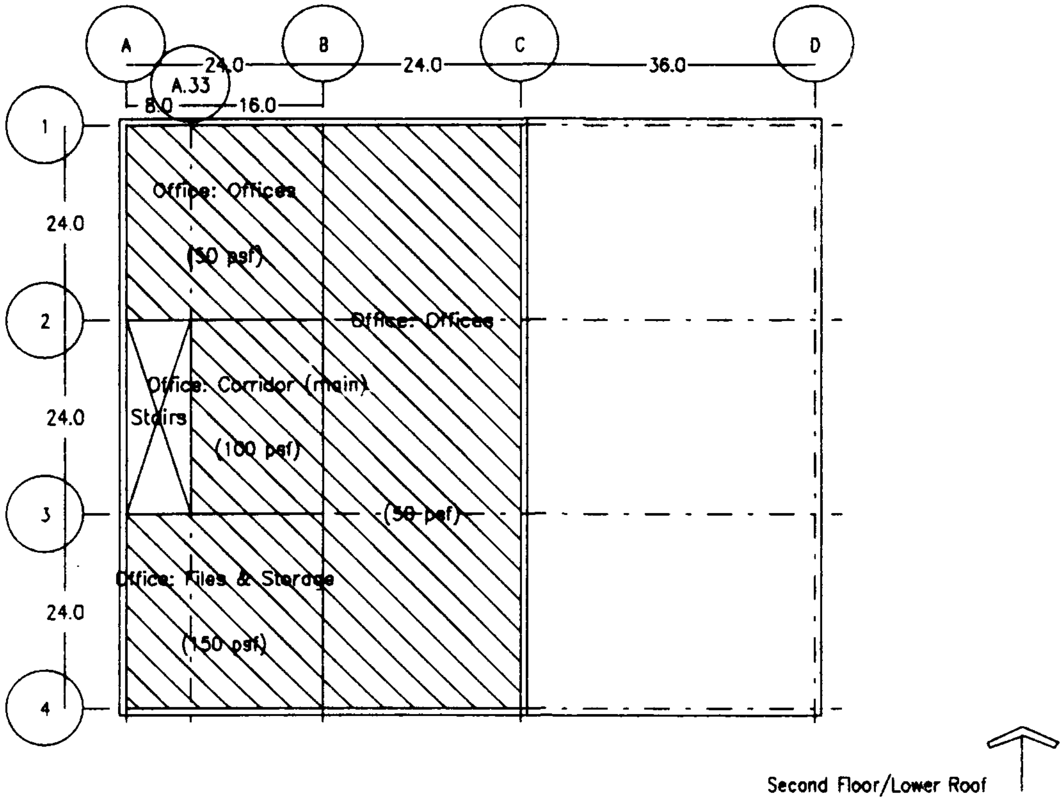
Stop Using Wall (DL)

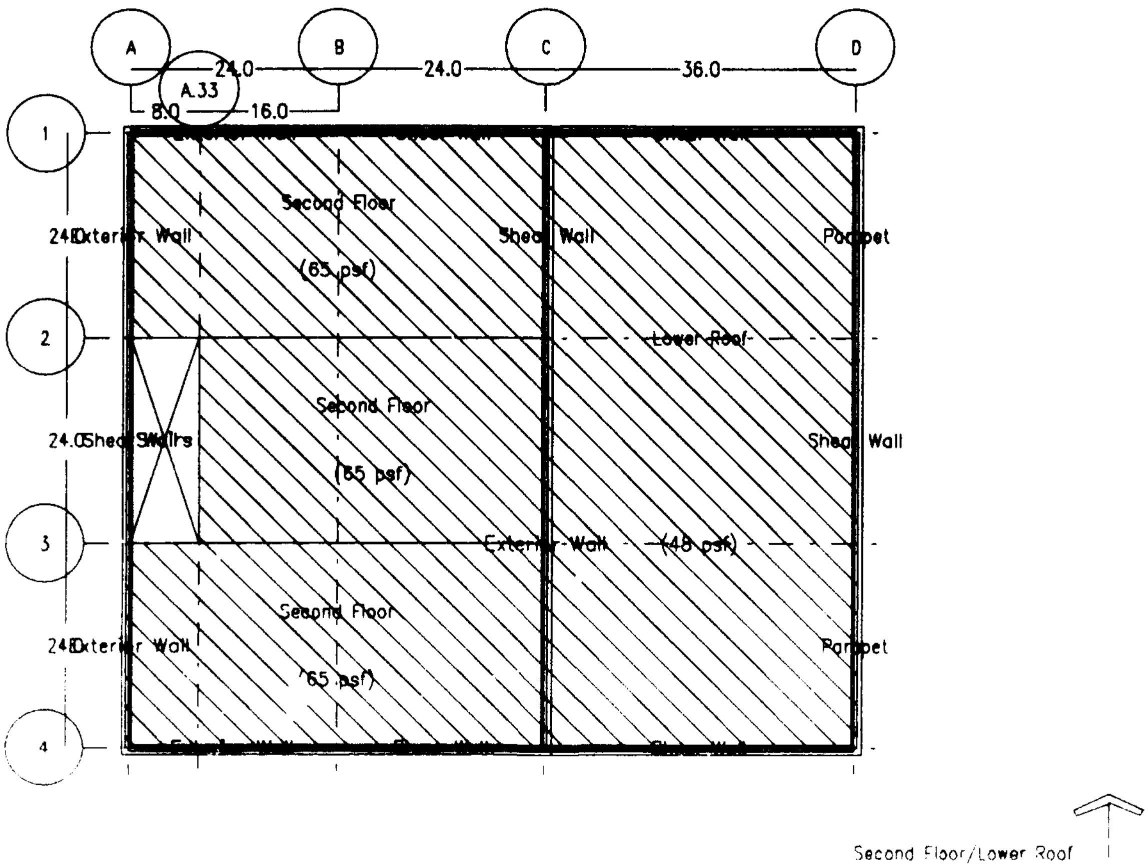
View Loads

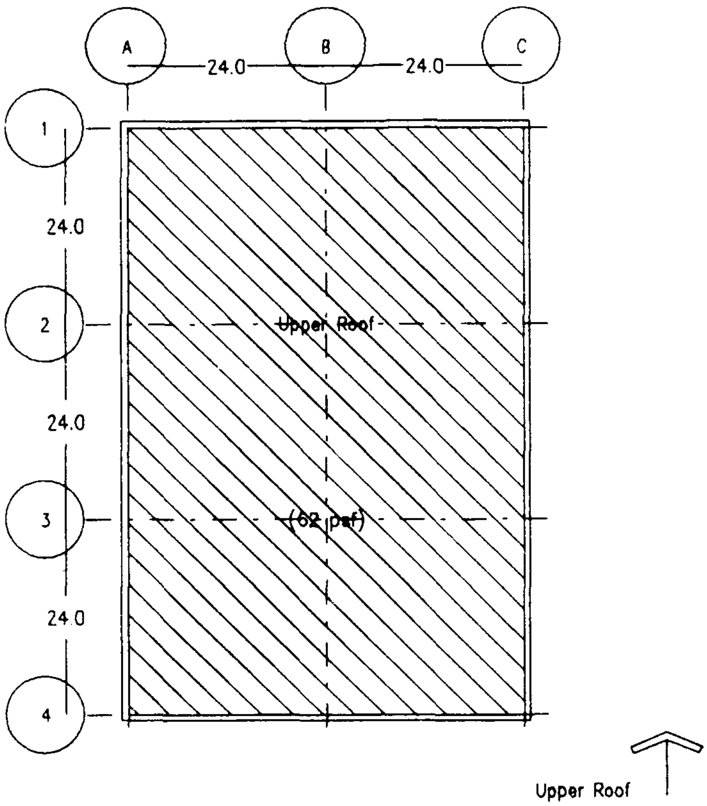
Show Loads

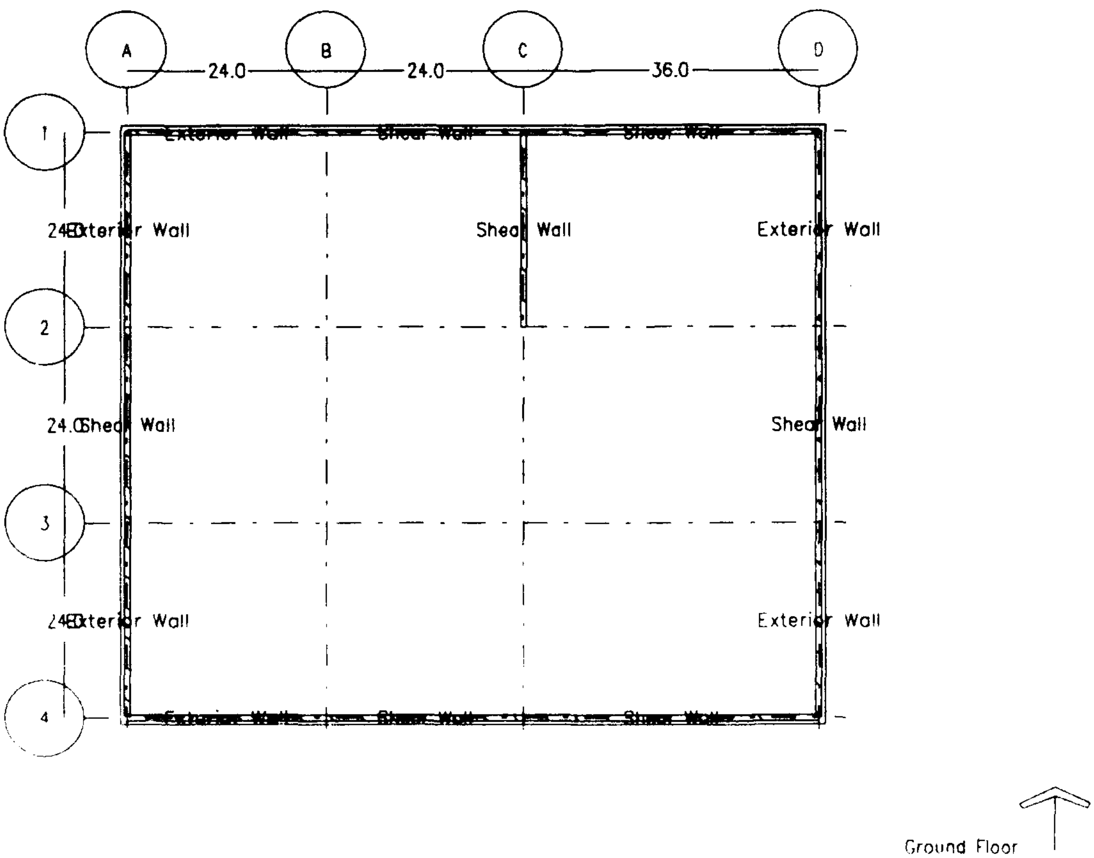
None

End


A
B
C
D
A.33
24.0
24.0
36.0
8.0
16.0
1
2
3
4
24.0
24.0
24.0
Office: Offices
(50 psf)
Office: Offices
Office: Corridor (main)
Stairs
(100 psf)
(50 psf)
Office: Files & Storage
(150 psf)
Second Floor/Lower Roof


A
B
C
D
A.33
24.0
24.0
36.0
8.0
16.0
1
2
3
4
Second Floor
(65 psf)
Exterior Wall
Shear Wall
Parapet
Lower Roof
Second Floor
(65 psf)
Stairs
Shear Wall
Exterior Wall
(48 psf)
Second Floor
(65 psf)
Exterior Wall
Parapet
Second Floor/Lower Roof

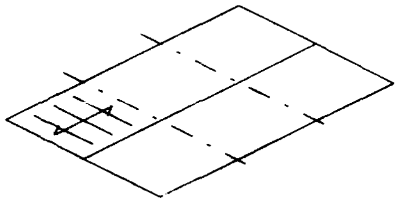

A
B
C
24.0
24.0
1
2
3
4
24.0
24.0
24.0
Upper Roof
(62 psf)
Upper Roof


A
B
C
D
24.0
24.0
36.0
1
2
3
4
24.0
24.0
24.0
Exterior Wall
Shear Wall
Shear Wall
Exterior Wall
Shear Wall
Exterior Wall
Shear Wall
Shear Wall
Exterior Wall
Exterior Wall
Exterior Wall
Shear Wall
Shear Wall
Ground Floor

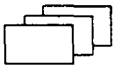
Analysis & Design Philosophy

Preliminary Analysis

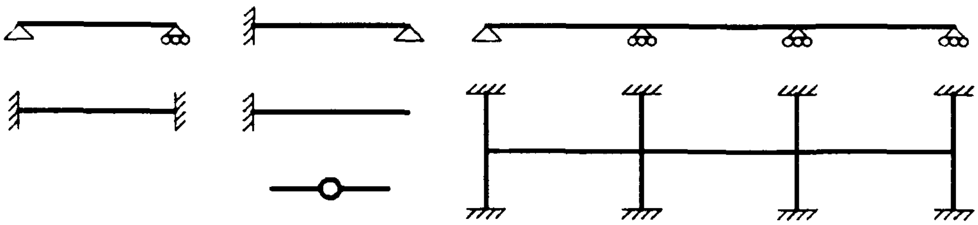
A. Select: * Material
* Load Combination
(Live Load Reduction)
* Element To Analyze



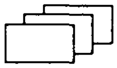
B. Review: * Attributes
* Guidelines



C. Connectivity

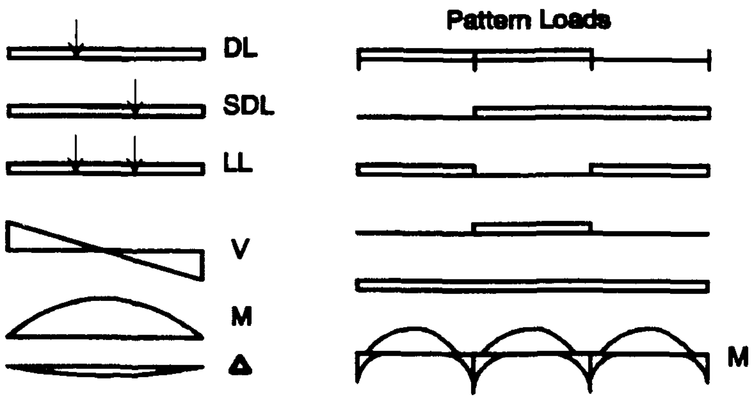


D. Self Weight Estimate * Guidelines



E. Analysis * Review Loads
* Connectivity

* Analysis Output
I = 1
E = 1
A = 1000

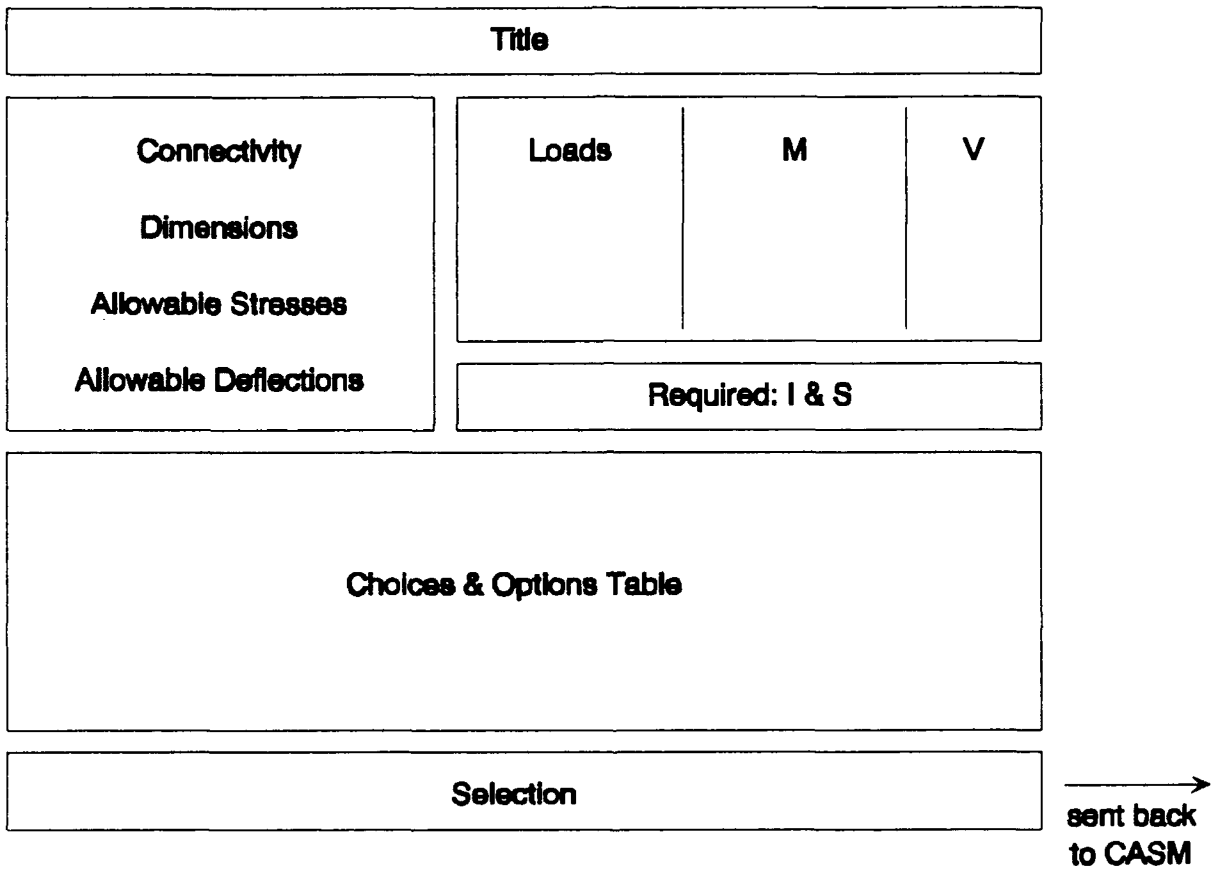


F. Re-Analysis (with real properties)

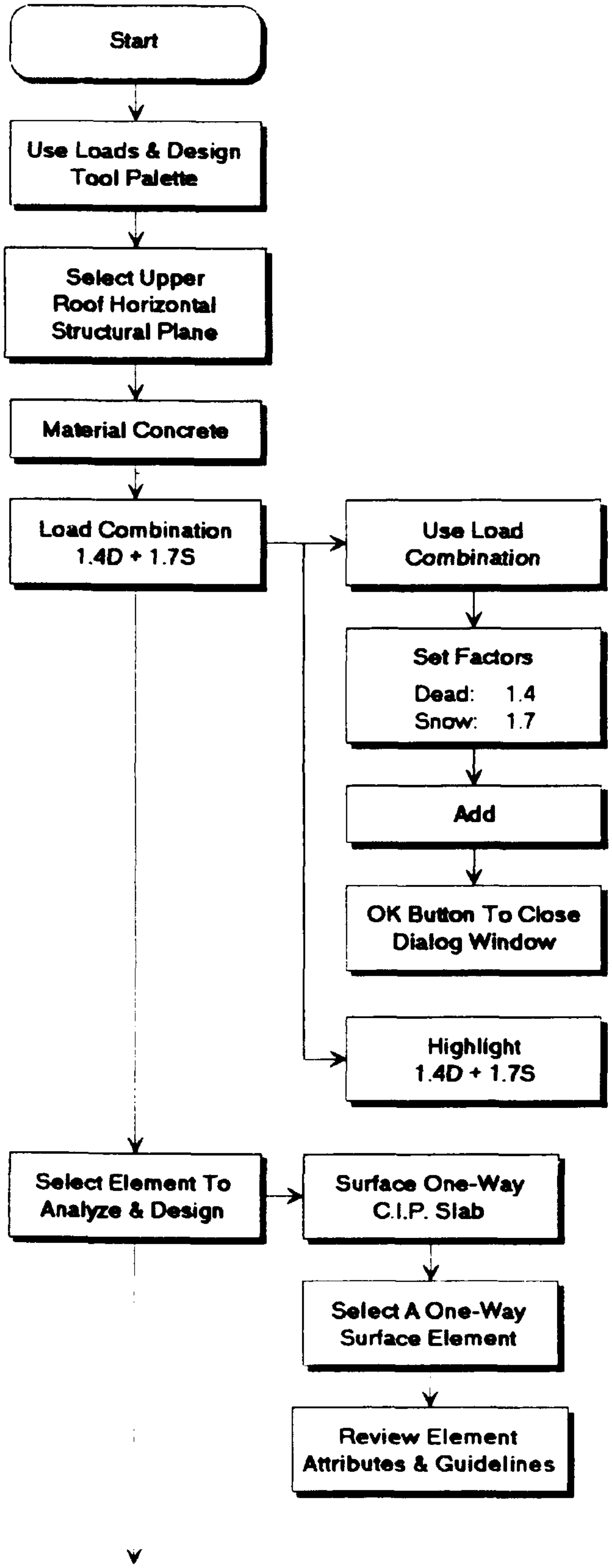
Preliminary Design

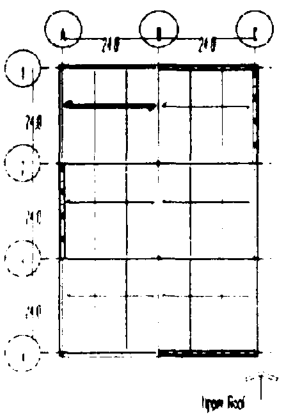
* Maximum V's, M's, R's, etc. sent to Excel

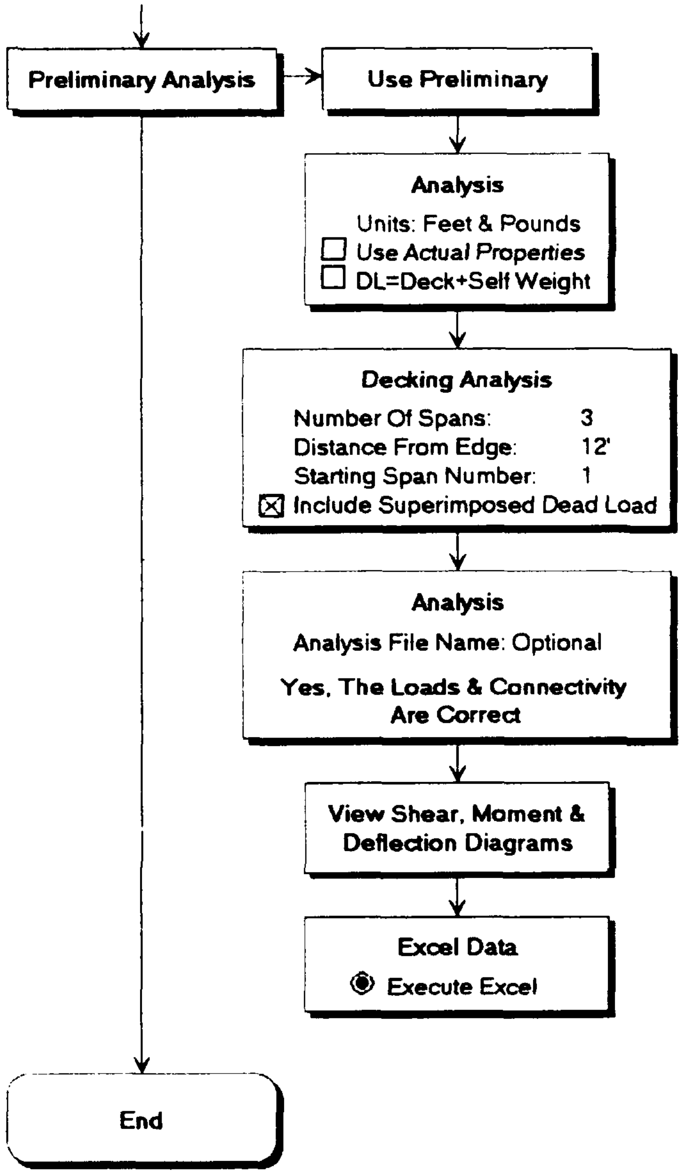
Spreadsheets

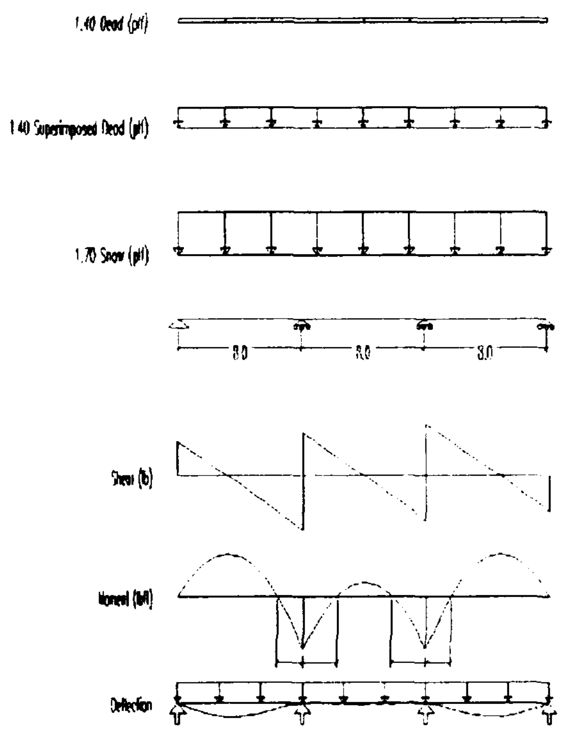


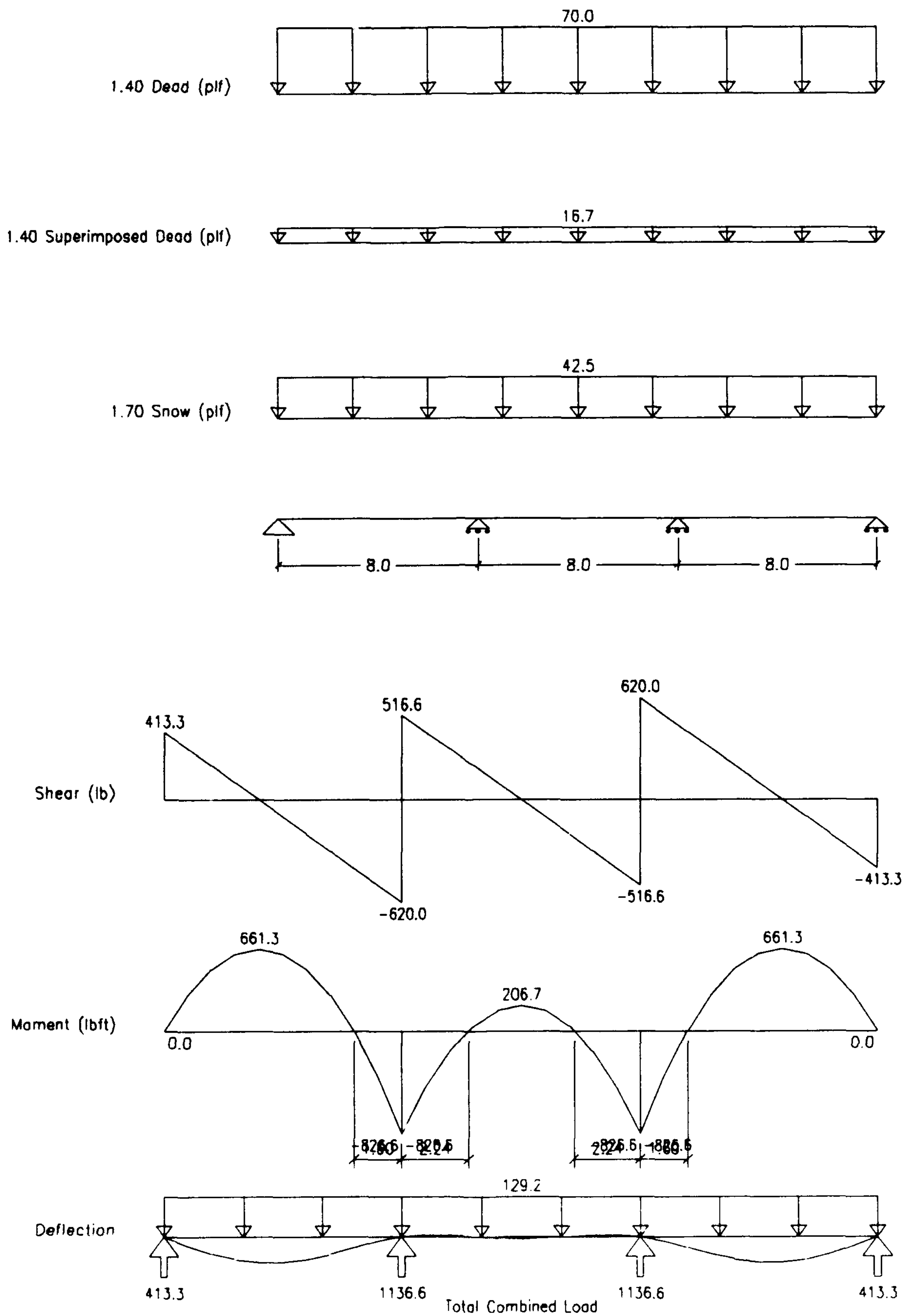
Surface Element Analysis





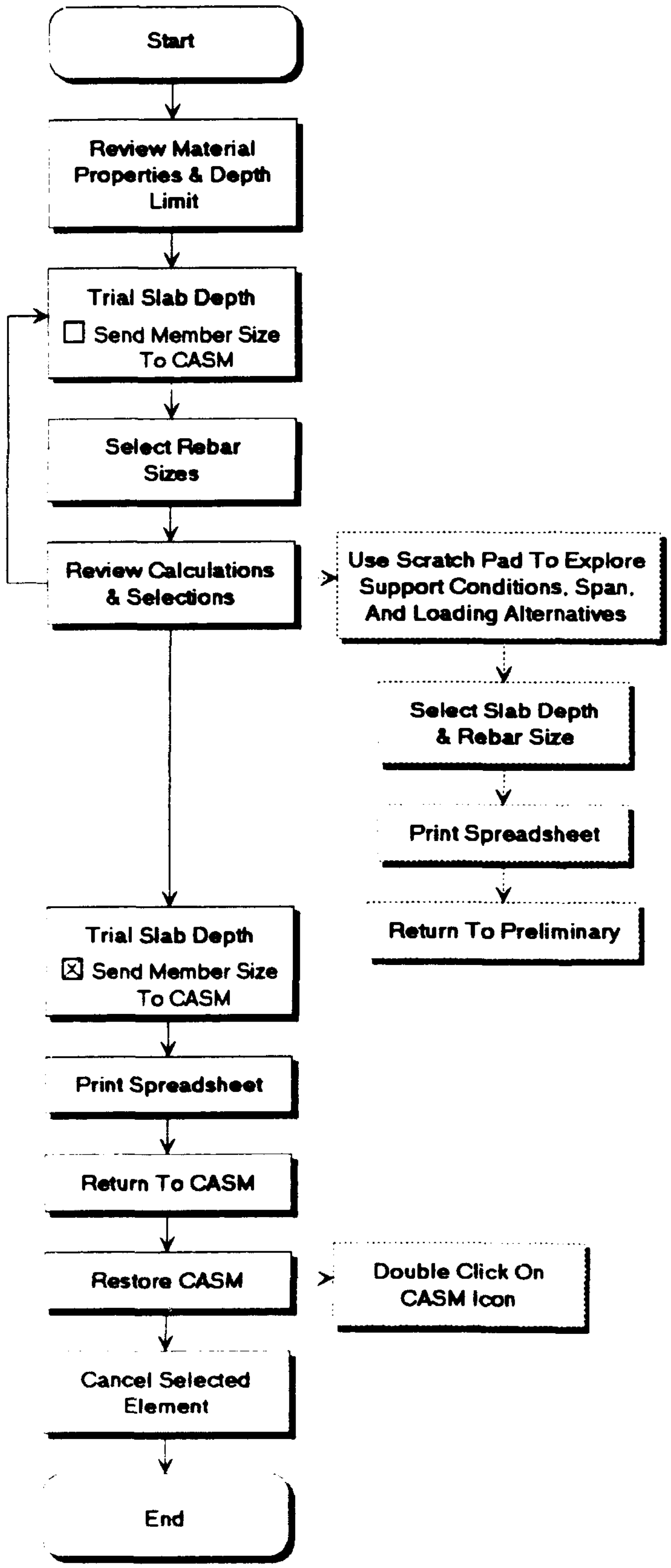

Preliminary Analysis
Use Preliminary
Analysis
Units: Feet & Pounds
Use Actual Properties
DL=Deck+Self Weight
Decking Analysis
Number Of Spans: 3
Distance From Edge: 12'
Starting Span Number: 1
Include Superimposed Dead Load
Analysis
Analysis File Name: Optional
Yes, The Loads & Connectivity Are Correct
View Shear, Moment & Deflection Diagrams
Excel Data
Execute Excel
End


1.40 Dead (plf)
1.40 Superimposed Dead (plf)
1.70 Snow (plf)
8.0
8.0
8.0
Shear (lb)
Deflection



70.0
1.40 Dead (plf)
16.7
1.40 Superimposed Dead (plf)
42.5
1.70 Snow (plf)
8.0
8.0
8.0
413.3
516.6
620.0
Shear (lb)
-620.0
-516.6
-413.3
661.3
661.3
206.7
Moment (lbft)
0.0
0.0
129.2
Deflection
413.3
1136.6
1136.6
413.3
Total Combined Load

Concrete Slab Design



Concrete Slab Selection

CONCRETE SLAB PRELIMINARY SELECTION

Project: Office Building - Scheme C	**Date: Feb 26, 1992**
Location: Radford AAP	**Engr:**

CASM Load & Analysis Data:

		Load Type	Factored Moments (k-ft) Left	Mid	Right	Fact. Reactions Left(k)	Right(k)
Method:	Analysis	Load Combination: 1.4D + 1.7S					
Member ID:							
Connectivity:	Beam (Left)						
	Beam (Right)	Dead	0.4	0.4	0.4	0.3	0.3
Slab Span:	8.0 ft	Sup Dead	0.1	0.1	0.1	0.1	0.1
Trib Width=	12.0 in	Live					
Depth Limit=	8.0 in. max	Lmin Roof					
Concrete F'c=	4.0 ksi	Snow	0.3	0.2	0.3	0.2	0.2
Concrete Wt=	145 pcf	Wind					
Steel Fy=	60.0 ksi	Summary	0.8	0.7	0.8	0.6	0.6

CASM Preliminary Slab Thickness/Values:

ACI Preliminary Dimensions:	Design Data:	Rebar Ratios:
ACI Depth: L/ 28.0 = 3.4 in	Bending phi(¢)= 0.90	pmax= 2.14 %
Trial Depth= 4.00 in Span= 3	beta(ß)= 0.85	1/2pmax= 1.07 %
Cover: Top= 0.75 in Btm= 0.75 in	m= 17.6	pmin= 0.33 %
d'= 1.00 in d= 3.00 in	Ru= 581 psi	

CASM Preliminary Slab Reinforcement:

		Left end Reqd	Left end Select	Midspan Reqd	Midspan Select	Right end Reqd	Right end Select		
Mu (kf)		0.83	1.74	0.66	1.74	0.83	1.74	Shear Capacity:	
Ru (psi)		102	215	82	215	102	215	¢Vc=	3.9 k
Reqd p (%)		0.19	0.37	0.15	0.37	0.19	0.37		
Reqd As (sq in.)		0.07	0.13	0.05	0.13	0.07	0.13	Shrinkage/Temp	
Rebar &	#4	18.00		18.00		18.00		Reinforcement	
Spacing	#5	18.00		18.00		18.00		Rqd As=	0.09
Options:	#6	18.00		18.00		18.00		Selected	
Selected Bar Size:		#4		#4		#4		Bar Size=	#3
Selected Spacing:		18 in		18 in		18 in		Spacing=	15 in
As (sq in/ft)= :		0.13		0.13		0.13		As=	0.09

4." slab Quantities:

Depth= 4.00 in	Conc Vol= .012 cy/sf	Rebar Wgt = .0005 tons/sf

Notes:

1. ACI 318-89 Strength Design used for sizing member.

Narrowly Spaced Element Analysis

Start

Use Loads & Design Tool Palette

Select Second Floor/ Lower Roof Horizontal Structural Plane

Material Steel

Load Combination D + S

Use Load Combination

Set Factors

Dead: 1.0
Snow: 1.0

Add

OK Button To Close Dialog Window

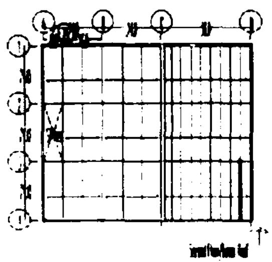
Highlight D+S In List

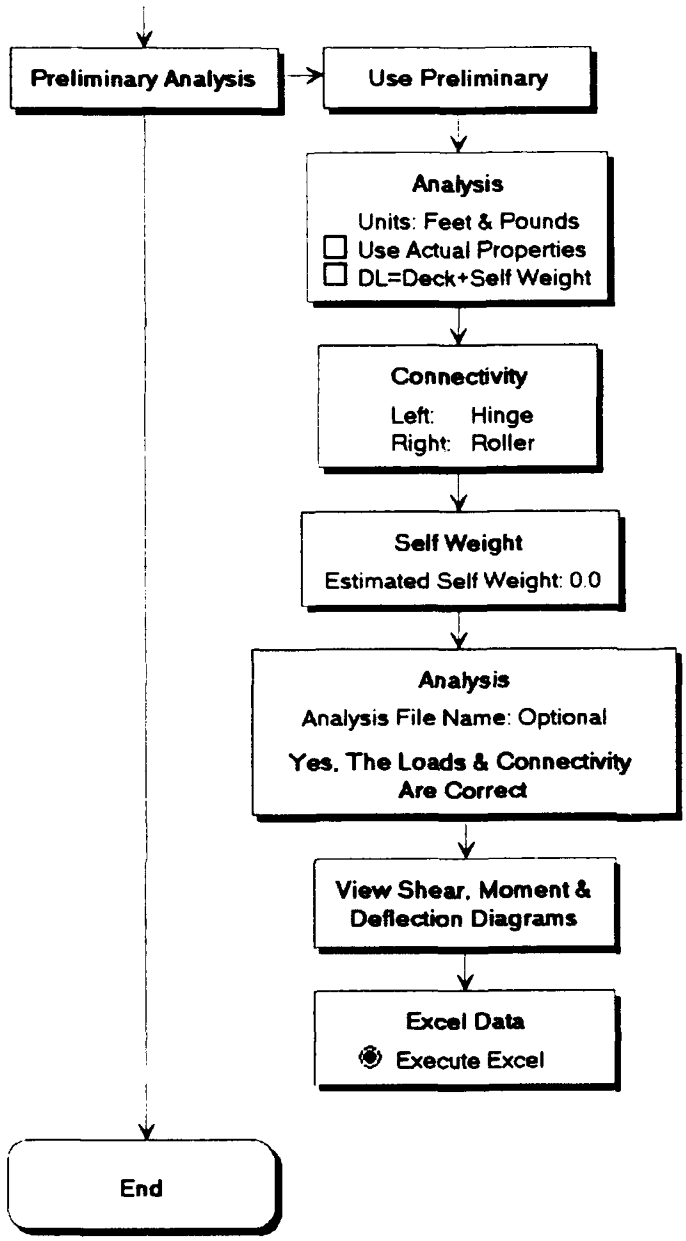
Select Element To Analyze & Design

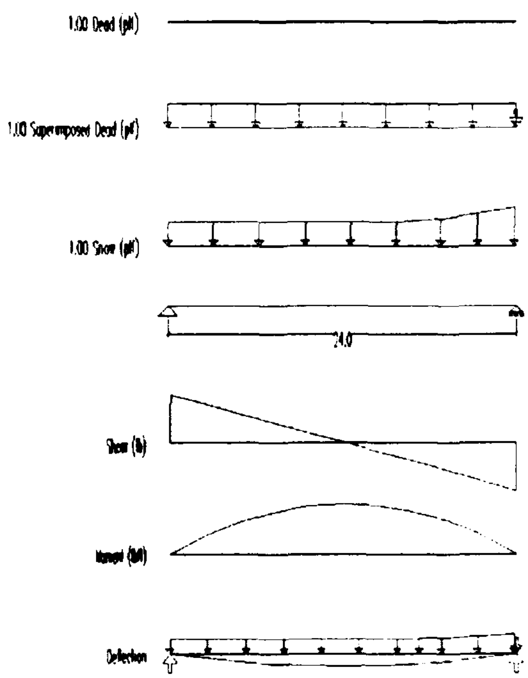
Linear Narrowly Spaced Open-Web Joist-K

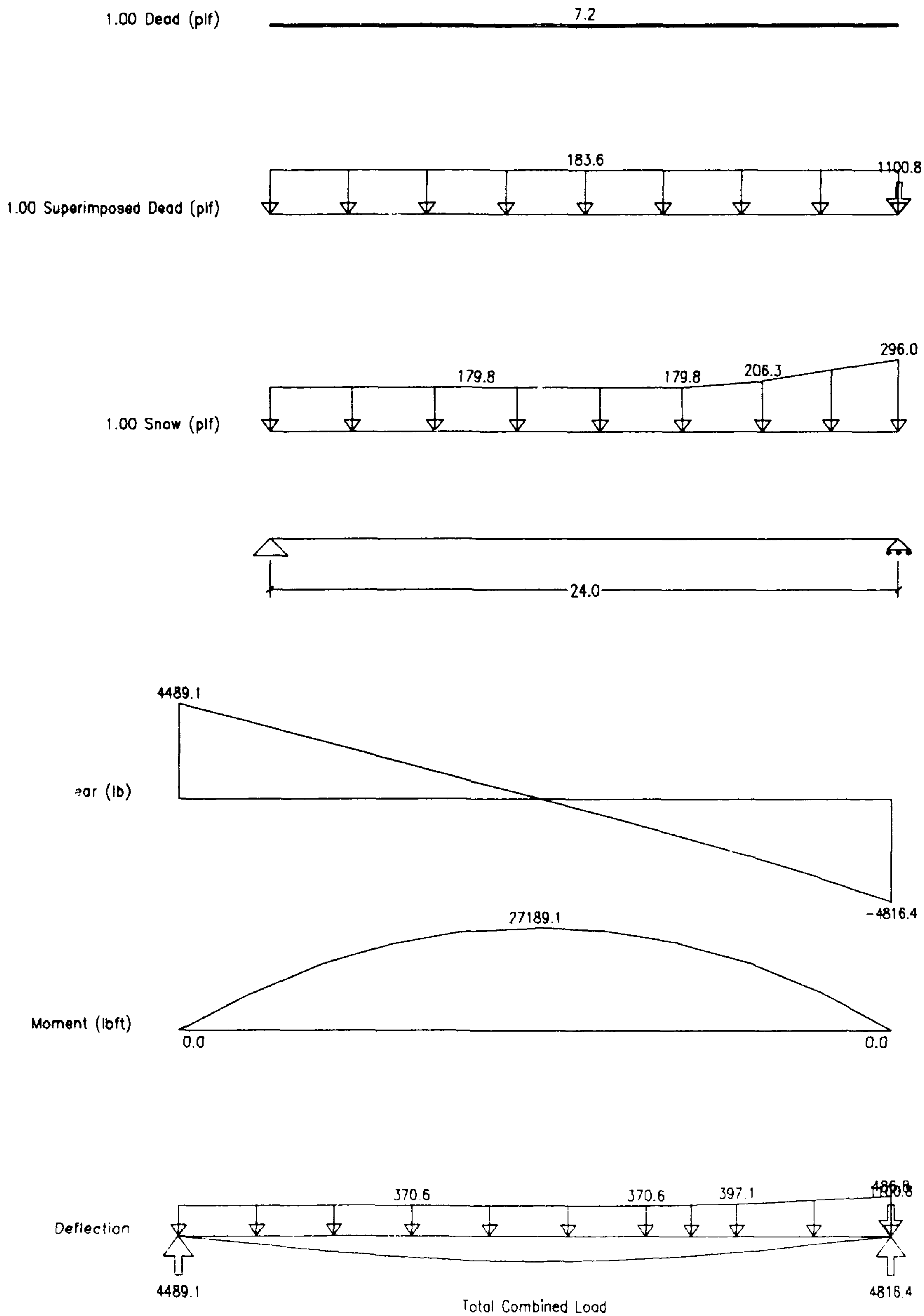
Select A Narrowly Spaced Element Near A Corner

Review Element Attributes & Guidelines




Preliminary Analysis
Use Preliminary
Analysis
Units: Feet & Pounds
Use Actual Properties
DL=Deck+Self Weight
Connectivity
Left: Hinge
Right: Roller
Self Weight
Estimated Self Weight: 0.0
Analysis
Analysis File Name: Optional
Yes, The Loads & Connectivity Are Correct
View Shear, Moment & Deflection Diagrams
Excel Data
Execute Excel
End


1.00 Dead (plf)
1.00 Superimposed Dead (plf)
1.00 Snow (plf)
24.0
Shear (lb)
Deflection


1.00 Dead (plf)
7.2
183.6
1100.8
1.00 Superimposed Dead (plf)
296.0
179.8
179.8
206.3
1.00 Snow (plf)
24.0
4489.1
ear (lb)
-4816.4
27189.1
Moment (lbft)
0.0
0.0
370.6
370.6
397.1
486.8
1100.8
Deflection
4489.1
4816.4
Total Combined Load

****
* TWO DIMENSIONAL FRAME ANALYSIS PROGRAM *
****

2-D FRAME ANALYSIS-V 8/77 RUN-Sun Jan 26, 1992 1:10 PM

****************************** I N P U T ******************************

Office Building - Scheme C -- Dead Load

NUMBER OF ELEMENTS	=	10
NUMBER OF NODAL POINTS	=	11
NUMBER OF MATERIALS	=	1
NUMBER OF ELEMENT TYPES	=	1
NUMBER OF ELASTIC SUPPORT TYPES	=	0
NUMBER OF FIXED END FORCE TYPES	=	1

MATERIAL TYPES

UNITS: INCHES, POUNDS

MATERIAL	YOUNG'S MODULUS	POISSON'S RATIO
1	1.0000	0.0000

MEMBER PROPERTIES

UNITS: INCHES

ELEMENT TYPE	AXIAL AREA	SHEAR AREA	MOMENT OF INERTIA
1	1000.0000	0.0000	1.0000

SUMMARY OF IN-SPAN LOADS

POSITIVE IS UPWARD AND COUNTERCLOCKWISE
UNITS: FEET, POUNDS

LOAD SET	LOAD TYPE	SPAN LENGTH	STARTING MAGNITUDE	STARTING POSITION	ENDING MAGNITUDE	ENDING POSITION
1	UNIFRM	2.40	-7.20	0.00		2.40

FIXED END FORCES IN LOCAL COORDINATES

UNITS: FEET, POUNDS

TYPE	AXIAL I	SHEAR I	MOMENT I	AXIAL J	SHEAR J	MOMENT J
1	0.000	8.640	3.456	0.000	8.640	-3.456

JOINT DATA

UNITS: FEET, POUNDS

		NODAL COORDINATES		BOUNDARY CONDITIONS NODAL FORCES AND MOMENTS			ELASTIC
NODE	CODE	X	Y	X	Y	Z	SUPPORT TYPE
1	110	13.00	0.00	0.00	0.00	0.00	0
2	0	15.40	0.00	0.00	0.00	0.00	0
3	0	17.80	0.00	0.00	0.00	0.00	0
4	0	20.20	0.00	0.00	0.00	0.00	0
5	0	22.60	0.00	0.00	0.00	0.00	0
6	0	25.00	0.00	0.00	0.00	0.00	0
7	0	27.40	0.00	0.00	0.00	0.00	0
8	0	29.80	0.00	0.00	0.00	0.00	0
9	0	32.20	0.00	0.00	0.00	0.00	0
10	0	34.60	0.00	0.00	0.00	0.00	0
11	10	37.00	0.00	0.00	0.00	0.00	0

MEMBER DATA

ELE	NODE I	NODE J	MAT TYPE	ELE TYPE	ELE CODE	F.E.F. TYPE	REL KIJ	STIFF KJI	CARRY OVER FACTOR
1	1	2	1	1	0	1	4.00	4.00	0.50
2	2	3	1	1	0	1	4.00	4.00	0.50
3	3	4	1	1	0	1	4.00	4.00	0.50
4	4	5	1	1	0	1	4.00	4.00	0.50
5	5	6	1	1	0	1	4.00	4.00	0.50
6	6	7	1	1	0	1	4.00	4.00	0.50
7	7	8	1	1	0	1	4.00	4.00	0.50
8	8	9	1	1	0	1	4.00	4.00	0.50
9	9	10	1	1	0	1	4.00	4.00	0.50
10	10	11	1	1	0	1	4.00	4.00	0.50

****************************** O U T P U T ******************************

JOINT DISPLACEMENTS

UNITS: INCHES, RADIANS AFTER DIVISION BY EI

JOINT	X-DISPLACEMENT	Y-DISPLACEMENT	Z-ROTATION
1	0.0000	0.0000	-597196.7842
2	0.0000	-16872481.3041	-563753.7643
3	0.0000	-31921840.2654	-472979.8531
4	0.0000	-43703338.4237	-339207.7734
5	0.0000	-51185019.7359	-176770.2481
6	0.0000	-53747710.5762	-0.0000
7	0.0000	-51185019.7359	176770.2481
8	0.0000	-43703338.4237	339207.7734
9	0.0000	-31921840.2654	472979.8531
10	0.0000	-16872481.3041	563753.7643
11	0.0000	0.0000	597196.7842

MEMBER END FORCES

UNITS: FEET, POUNDS

ELE	AXIAL I	SHEAR I	MOMENT I	AXIAL J	SHEAR J	MOMENT J
1	0.000	86.400	-0.000	0.000	-69.120	186.624
2	0.000	69.120	-186.624	0.000	-51.840	331.776
3	0.000	51.840	-331.776	0.000	-34.560	435.456
4	0.000	34.560	-435.456	0.000	-17.280	497.664
5	0.000	17.280	-497.664	0.000	-0.000	518.400
6	0.000	0.000	-518.400	0.000	17.280	497.664
7	0.000	-17.280	-497.664	0.000	34.560	435.456
8	0.000	-34.560	-435.456	0.000	51.840	331.776
9	0.000	-51.840	-331.776	0.000	69.120	186.624
10	0.000	-69.120	-186.624	0.000	86.400	0.000

APPLIED JOINT LOADS AND SUPPORT REACTIONS

UNITS: FEET, POUNDS

NODE	FORCE X	FORCE Y	MOMENT Z
1	0.000	86.400	-0.000
2	0.000	0.000	0.000
3	0.000	-0.000	0.000
4	0.000	0.000	0.000
5	0.000	-0.000	-0.000
6	0.000	0.000	0.000
7	0.000	-0.000	0.000
8	0.000	-0.000	0.000
9	0.000	0.000	0.000
10	0.000	-0.000	0.000
11	0.000	86.400	0.000

PROBLEMS COMPLETED

****
* TWO DIMENSIONAL FRAME ANALYSIS PROGRAM *
****

2-D FRAME ANALYSIS-V 8/77 RUN-Sun Jan 26, 1992 1:10 PM

****************************** I N P U T ******************************

Office Building - Scheme C -- Superimposed Dead Load

NUMBER OF ELEMENTS	=	10
NUMBER OF NODAL POINTS	=	11
NUMBER OF MATERIALS	=	1
NUMBER OF ELEMENT TYPES	=	1
NUMBER OF ELASTIC SUPPORT TYPES	=	0
NUMBER OF FIXED END FORCE TYPES	=	1

MATERIAL TYPES

UNITS: INCHES, POUNDS

MATERIAL	YOUNG'S MODULUS	POISSON'S RATIO
1	1.0000	0.0000

MEMBER PROPERTIES

UNITS: INCHES

ELEMENT TYPE	AXIAL AREA	SHEAR AREA	MOMENT OF INERTIA
1	1000.0000	0.0000	1.0000

SUMMARY OF IN-SPAN LOADS

POSITIVE IS UPWARD AND COUNTERCLOCKWISE
UNITS: FEET, POUNDS

LOAD SET	LOAD TYPE	SPAN LENGTH	STARTING MAGNITUDE	STARTING POSITION	ENDING MAGNITUDE	ENDING POSITION
1	UNIFORM	2.40	-183.60	0.00		2.40

FIXED END FORCES IN LOCAL COORDINATES

UNITS: FEET, POUNDS

TYPE	AXIAL I	SHEAR I	MOMENT I	AXIAL J	SHEAR J	MOMENT J
1	0.000	220.320	88.128	0.000	220.320	-88.128

JOINT DATA

UNITS: FEET, POUNDS

				BOUNDARY CONDITIONS			
		NODAL COORDINATES		NODAL FORCES AND MOMENTS			ELASTIC
NODE	CODE	X	Y	X	Y	S	SUPPORT TYPE
1	110	13.00	0.00	0.00	0.00	0.00	0
2	0	15.40	0.00	0.00	0.00	0.00	0
3	0	17.80	0.00	0.00	0.00	0.00	0
4	0	20.20	0.00	0.00	0.00	0.00	0
5	0	22.60	0.00	0.00	0.00	0.00	0
6	0	25.00	0.00	0.00	0.00	0.00	0
7	0	27.40	0.00	0.00	0.00	0.00	0
8	0	29.80	0.00	0.00	0.00	0.00	0
9	0	32.20	0.00	0.00	0.00	0.00	0
10	0	34.60	0.00	0.00	0.00	0.00	0
11	10	37.00	0.00	0.00	0.00	0.00	0

MEMBER DATA

ELE	NODE I	NODE J	MAT TYPE	ELE TYPE	ELE CODE	F.E.F. TYPE	REL KIJ	STIFF KJI	CARRY OVER FACTOR
1	1	2	1	1	0	1	4.00	4.00	0.50
2	2	3	1	1	0	1	4.00	4.00	0.50
3	3	4	1	1	0	1	4.00	4.00	0.50
4	4	5	1	1	0	1	4.00	4.00	0.50
5	5	6	1	1	0	1	4.00	4.00	0.50
6	6	7	1	1	0	1	4.00	4.00	0.50
7	7	8	1	1	0	1	4.00	4.00	0.50
8	8	9	1	1	0	1	4.00	4.00	0.50
9	9	10	1	1	0	1	4.00	4.00	0.50
10	10	11	1	1	0	1	4.00	4.00	0.50

******************************** O U T P U T ********************************

JOINT DISPLACEMENTS

UNITS: INCHES, RADIANS AFTER DIVISION BY EI

JOINT	X-DISPLACEMENT	Y-DISPLACEMENT	S-ROTATION
1	0.0000	0.0000	-15220518.6689
2	0.0000	-430240292.2500	-14375721.6235
3	0.0000	-814006962.7074	-12060986.7830
4	0.0000	-1114435179.0084	-8649798.6040
5	0.0000	-1305218060.8929	-4507641.5260
6	0.0000	-1370546680.2051	-0.0000
7	0.0000	-1305218060.8929	4507641.5260
8	0.0000	-1114435179.0084	8649798.6040
9	0.0000	-814006962.7074	12060986.7830
10	0.0000	-430240292.2500	14375721.6235
11	0.0000	0.0000	15220518.6689

MEMBER END FORCES

UNITS: FEET, POUNDS

ELE	AXIAL I	SHEAR I	MOMENT I	AXIAL J	SHEAR J	MOMENT J
1	0.000	2203.200	0.000	0.000	-1762.560	4758.912
2	0.000	1762.560	-4758.912	0.000	-1321.920	8460.289
3	0.000	1321.920	-8460.289	0.000	-881.280	11104.128
4	0.000	881.280	-11104.128	0.000	-440.640	12690.433
5	0.000	440.640	-12690.433	0.000	0.000	13219.201
6	0.000	-0.000	-13219.201	0.000	440.640	12690.433
7	0.000	-440.640	-12690.433	0.000	881.280	11104.128
8	0.000	-881.280	-11104.128	0.000	1321.920	8460.289
9	0.000	-1321.920	-8460.289	0.000	1762.560	4758.912
10	0.000	-1762.560	-4758.912	0.000	2203.200	-0.000

APPLIED JOINT LOADS AND SUPPORT REACTIONS

UNITS: FEET, POUNDS

NODE	FORCE X	FORCE Y	MOMENT S
1	0.000	2203.200	0.000
2	0.000	-0.000	0.000
3	0.000	0.000	-0.000
4	0.000	0.000	-0.000
5	0.000	-0.000	-0.000
6	0.000	0.000	-0.000
7	0.000	0.000	-0.000
8	0.000	0.000	0.000
9	0.000	0.000	0.000
10	0.000	-0.000	0.000
11	0.000	2203.200	-0.000

PROBLEM COMPLETED

****
* TWO DIMENSIONAL FRAME ANALYSIS PROGRAM *
****

2-D FRAME ANALYSIS-V 8/77 RUN-Sun Jan 26, 1992 1:10 PM

******************************** I N P U T ********************************

Office Building - Scheme C -- Snow Load

NUMBER OF ELEMENTS	=	10
NUMBER OF NODAL POINTS	=	11
NUMBER OF MATERIALS	=	1
NUMBER OF ELEMENT TYPES	=	1
NUMBER OF ELASTIC SUPPORT TYPES	=	0
NUMBER OF FIXED END FORCE TYPES	=	5

MATERIAL TYPES

UNITS: INCHES, POUNDS

MATERIAL	YOUNG'S MODULUS	POISSON'S RATIO
1	1.0000	0.0000

MEMBER PROPERTIES

UNITS: INCHES

ELEMENT TYPE	AXIAL AREA	SHEAR AREA	MOMENT OF INERTIA
1	1000.0000	0.0000	1.0000

SUMMARY OF IN-SPAN LOADS

POSITIVE IS UPWARD AND COUNTERCLOCKWISE
UNITS: FEET, POUNDS

LOAD SET	LOAD TYPE	SPAN LENGTH	STARTING MAGNITUDE	STARTING POSITION	ENDING MAGNITUDE	ENDING POSITION
1	UNIFRM	2.40	-179.76	0.00		2.40
2	UNIFRM	2.40	-179.76	0.00		1.32
2	RAMP	2.40	-179.76	1.32	-189.06	2.40
3	RAMP	2.40	-189.06	0.00	-206.35	2.00
3	RAMP	2.40	-206.35	2.00	-213.18	2.40
4	RAMP	2.40	-213.18	0.00	-254.59	2.40
5	RAMP	2.40	-254.59	0.00	-296.00	2.40

FIXED END FORCES IN LOCAL COORDINATES

UNITS: FEET, POUNDS

TYPE	AXIAL I	SHEAR I	MOMENT I	AXIAL J	SHEAR J	MOMENT J
1	0.000	215.713	86.285	0.000	215.713	-86.285
2	0.000	216.120	86.581	0.000	220.311	-87.387
3	0.000	234.336	94.731	0.000	244.933	-96.788
4	0.000	270.727	110.278	0.000	290.603	-114.254
5	0.000	320.417	130.154	0.000	340.293	-134.130

JOINT DATA

UNITS: FEET, POUNDS

				BOUNDARY CONDITIONS			
		NODAL COORDINATES		NODAL FORCES AND MOMENTS			ELASTIC
NODE	CODE	X	Y	X	Y	Z	SUPPORT TYPE
1	110	13.00	0.00	0.00	0.00	0.00	0
2	0	15.40	0.00	0.00	0.00	0.00	0
3	0	17.80	0.00	0.00	0.00	0.00	0
4	0	20.20	0.00	0.00	0.00	0.00	0
5	0	22.60	0.00	0.00	0.00	0.00	0
6	0	25.00	0.00	0.00	0.00	0.00	0
7	0	27.40	0.00	0.00	0.00	0.00	0
8	0	29.80	0.00	0.00	0.00	0.00	0
9	0	32.20	0.00	0.00	0.00	0.00	0
10	0	34.60	0.00	0.00	0.00	0.00	0
11	10	37.00	0.00	0.00	0.00	0.00	0

MEMBER DATA

ELE	NODE I	NODE J	MAT TYPE	ELE TYPE	ELE CODE	F.E.F. TYPE	REL KIJ	STIFF KJI	CARRY OVER FACTOR
1	1	2	1	1	0	1	4.00	4.00	0.50
2	2	3	1	1	0	1	4.00	4.00	0.50
3	3	4	1	1	0	1	4.00	4.00	0.50
4	4	5	1	1	0	1	4.00	4.00	0.50
5	5	6	1	1	0	1	4.00	4.00	0.50
6	6	7	1	1	0	1	4.00	4.00	0.50
7	7	8	1	1	0	2	4.00	4.00	0.50
8	8	9	1	1	0	3	4.00	4.00	0.50
9	9	10	1	1	0	4	4.00	4.00	0.50
10	10	11	1	1	0	5	4.00	4.00	0.50

****************************** O U T P U T ******************************

JOINT DISPLACEMENTS

UNITS: INCHES, RADIANS AFTER DIVISION BY EI

JOINT	X-DISPLACEMENT	Y-DISPLACEMENT	Z-ROTATION
1	0.0000	0.0000	-15477674.9686
2	0.0000	-437429473.1567	-14625130.2757
3	0.0000	-870320035.9828	-12306057.6766
4	0.0000	-1135615012.7337	-8878299.3904
5	0.0000	-1332510783.5772	-4689697.6362
6	0.0000	-1402544704.5933	-128094.6333
7	0.0000	-1339551507.7742	4478667.3991
8	0.0000	-1147671481.9354	8762676.3217
9	0.0000	-841413597.1693	12358723.8440
10	0.0000	-446233743.7972	14886528.1648
11	0.0000	0.0000	15819665.5358

MEMBER END FORCES

UNITS: FEET, POUNDS

ELE	AXIAL I	SHEAR I	MOMENT I	AXIAL J	SHEAR J	MOMENT J
1	0.000	2199.520	0.000	0.000	-1768.094	4761.137
2	0.000	1768.094	-4761.137	0.000	-1336.668	8486.852
3	0.000	1336.668	-8486.852	0.000	-905.241	11177.143
4	0.000	905.241	-11177.143	0.000	-473.815	12832.011
5	0.000	473.815	-12832.011	0.000	-42.389	13451.456
6	0.000	42.389	-13451.456	0.000	389.037	13035.477
7	0.000	-389.037	-13035.477	0.000	825.477	11582.273
8	0.000	-825.477	-11582.273	0.000	1304.746	9036.668
9	0.000	-1304.746	-9036.668	0.000	1866.076	5251.558
10	0.000	-1866.076	-5251.558	0.000	2526.785	-0.000

APPLIED JOINT LOADS AND SUPPORT REACTIONS

UNITS: FEET, POUNDS

NODE	FORCE X	FORCE Y	MOMENT Z
1	0.000	2199.520	0.000
2	0.000	-0.000	0.000
3	0.000	-0.000	0.000
4	0.000	0.000	-0.000
5	0.000	0.000	-0.000
6	0.000	0.000	0.000
7	0.000	0.000	0.000
8	0.000	-0.000	-0.000
9	0.000	0.000	0.000
10	0.000	-0.000	0.000
11	0.000	2526.785	-0.000

PROBLEM COMPLETED

****
* TWO DIMENSIONAL FRAME ANALYSIS PROGRAM *
****

2-D FRAME ANALYSIS-V 8/77 RUN-Sun Jan 26, 1992 1:10 PM

******************************** I N P U T ********************************

Office Building - Scheme C -- Total Combined Load

NUMBER OF ELEMENTS	=	10
NUMBER OF NODAL POINTS	=	11
NUMBER OF MATERIALS	=	1
NUMBER OF ELEMENT TYPES	=	1
NUMBER OF ELASTIC SUPPORT TYPES	=	0
NUMBER OF FIXED END FORCE TYPES	=	5

MATERIAL TYPES

UNITS: INCHES, POUNDS

MATERIAL	YOUNG'S MODULUS	POISSON'S RATIO
1	1.0000	0.0000

MEMBER PROPERTIES

UNITS: INCHES

ELEMENT TYPE	AXIAL AREA	SHEAR AREA	MOMENT OF INERTIA
1	1000.0000	0.0000	1.0000

SUMMARY OF IN-SPAN LOADS

POSITIVE IS UPWARD AND COUNTERCLOCKWISE
UNITS: FEET, POUNDS

LOAD SET	LOAD TYPE	SPAN LENGTH	STARTING MAGNITUDE	STARTING POSITION	ENDING MAGNITUDE	ENDING POSITION
1	UNIFRM	2.40	-370.56	0.00		2.40
2	UNIFRM	2.40	-190.80	0.00		2.40
2	UNIFRM	2.40	-179.76	0.00		1.32
2	RAMP	2.40	-179.76	1.32	-189.06	2.40
3	UNIFRM	2.40	-190.80	0.00		2.40
3	RAMP	2.40	-189.06	0.00	-206.35	2.00
3	RAMP	2.40	-206.35	2.00	-213.18	2.40
4	UNIFRM	2.40	-190.80	0.00		2.40
4	RAMP	2.40	-213.18	0.00	-254.59	2.40
5	UNIFRM	2.40	-190.80	0.00		2.40
5	RAMP	2.40	-254.59	0.00	-296.00	2.40

FIXED END FORCES IN LOCAL COORDINATES

UNITS: FEET, POUNDS

TYPE	AXIAL I	SHEAR I	MOMENT I	AXIAL J	SHEAR J	MOMENT J
1	0.000	444.673	177.869	0.000	444.673	-177.869
2	0.000	445.088	178.165	0.000	449.271	-178.971
3	0.000	463.296	186.315	0.000	473.893	-188.372
4	0.000	499.687	201.062	0.000	519.563	-205.838
5	0.000	549.377	221.738	0.000	569.253	-225.714

JOINT DATA

UNITS: FEET, POUNDS

NODE	CODE	NODAL COORDINATES X	NODAL COORDINATES Y	BOUNDARY CONDITIONS NODAL FORCES AND MOMENTS X	Y	Z	ELASTIC SUPPORT TYPE
1	110	13.00	0.00	0.00	0.00	0.00	0
2	0	15.40	0.00	0.00	0.00	0.00	0
3	0	17.80	0.00	0.00	0.00	0.00	0
4	0	20.20	0.00	0.00	0.00	0.00	0
5	0	22.60	0.00	0.00	0.00	0.00	0
6	0	25.00	0.00	0.00	0.00	0.00	0
7	0	27.40	0.00	0.00	0.00	0.00	0
8	0	29.80	0.00	0.00	0.00	0.00	0
9	0	32.20	0.00	0.00	0.00	0.00	0
10	0	34.60	0.00	0.00	0.00	0.00	C
11	10	37.00	0.00	0.00	0.00	0.00	0

MEMBER DATA

ELE	NODE I	NODE J	MAT TYPE	ELE TYPE	ELE CODE	F.E.F. TYPE	REL KIJ	STIFF KJI	CARRY OVER FACTOR
1	1	2	1	1	0	1	4.00	4.00	0.50
2	2	3	1	1	0	1	4.00	4.00	0.50
3	3	4	1	1	0	1	4.00	4.00	0.50
4	4	5	1	1	0	1	4.00	4.00	0.50
5	5	6	1	1	0	1	4.00	4.00	0.50
6	6	7	1	1	0	1	4.00	4.00	0.50
7	7	8	1	1	0	2	4.00	4.00	0.50
8	8	9	1	1	0	3	4.00	4.00	0.50
9	9	10	1	1	0	4	4.00	4.00	0.50
10	10	11	1	1	0	5	4.00	4.00	0.50

******************************** O U T P U T ********************************

JOINT DISPLACEMENTS

UNITS: INCHES, RADIANS AFTER DIVISION BY EI

JOINT	X-DISPLACEMENT	Y-DISPLACEMENT	Z-ROTATION
1	0.0000	0.0000	-31303390.4217
2	0.0000	-884550246.7100	-29564605.6635
3	0.0000	-1674257638.9556	-24840824.3155
4	0.0000	-2293733930.1650	-17867305.7678
5	0.0000	-2688913864.2061	-9304109.4104
6	0.0000	-2828859178.3746	-128094.6333
7	0.0000	-2695954580.4031	9163079.1732
8	0.0000	-2305809999.3675	17751682.6991
9	0.0000	-1687342400.1422	24892690.4829
10	0.0000	-893354817.3513	29806003.5525
11	0.0000	0.0000	31645380.9890

MEMBER END FORCES

UNITS: FEET, POUNDS

ELE	AXIAL I	SHEAR I	MOMENT I	AXIAL J	SHEAR J	MOMENT J
1	0.000	4489.120	0.000	0.000	-3599.774	9706.674
2	0.000	3599.774	-9706.674	0.000	-2710.428	17276.916
3	0.000	2710.428	-17276.916	0.000	-1821.081	22716.727
4	0.000	1821.081	-22716.727	0.000	-931.735	26020.107
5	0.000	931.735	-26020.107	0.000	-42.389	27109.055
6	0.000	42.389	-27109.055	0.000	846.957	26223.574
7	0.000	-846.957	-26223.574	0.000	1741.317	23121.859
8	0.000	-1741.317	-23121.859	0.000	2670.506	17828.732
9	0.000	-2670.506	-17828.732	0.000	3697.756	10197.094
10	0.000	-3697.756	-10197.094	0.000	4816.386	0.000

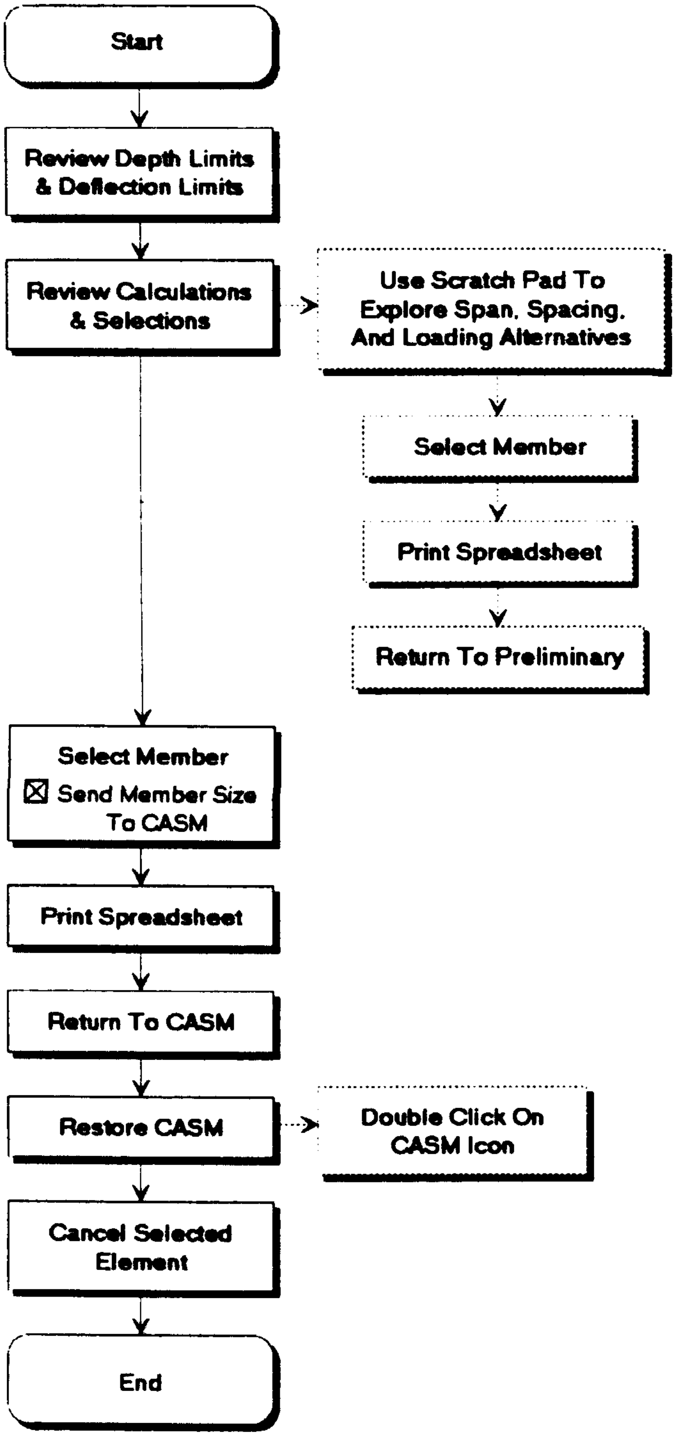
APPLIED JOINT LOADS AND SUPPORT REACTIONS

UNITS: FEET, POUNDS

NODE	FORCE X	FORCE Y	MOMENT Z
1	0.000	4489.120	0.000
2	0.000	-0.000	0.000
3	0.000	0.000	0.000
4	0.000	0.000	-0.000
5	0.000	0.000	-0.000
6	0.000	-0.000	-0.000
7	0.000	0.000	-0.000
8	0.000	0.000	0.000
9	0.000	-0.000	0.000
10	0.000	-0.000	0.000
11	0.000	4816.386	0.000

PROBLEMS COMPLETED

Steel Open-Web Joist Design



Barjoist Selection

STEEL BAR JOIST PRELIMINARY SELECTION

Project: Office Building - Scheme C	Date: Feb 26, 1992
Location: Radford AAP	Engr:

CASM Load & Analysis Data:

Method: Analysis

Load Combination: D + S

Member ID:	
Connection:	Hinge (Left)
	Roller (Right)
Span:	24.0 ft
Spacing:	48.0 in
Depth Limit=	24.0 in. max
Fy=	36.0 ksi
Fb=	24.0 ksi
E =	29,000 ksi
Live Defl=	L/360= 0.80 in
Total Defl=	L/240= 1.20 in

	Factored Moment (ft-lb)			Factored Reaction	
LoadType	Left	Mid	Right	Left(lb)	Right(lb)
Dead		518		86	86
Sup Dead		13,219		2,203	2,203
Live					
Lmin Roof					
Snow		13,451		2,200	2,527
Wind					
Summary		27,189		4,489	4,816

Moment: (EUL)		Reaction: (EUL)	
Total Ld=	378 plf	Total Ld=	401 plf
Live Ld=	187 plf	Live Ld=	211 plf

CASM Joist Selection Table: (joist capacities)

Joist Size	Spacing (in)	Total Ld(plf)	Live Ld(plf)	Mmax (ftlb)	Rmax (lb)	Live Ld Defl(in)	Total Ld Defl(in)	Joist Weight (psf)	Joist Weight (plf)
20K4	48.0	430	353	30,960	5,160	0.48	0.92	1.9	7.6
18K5	48.0	434	318	31,248	5,208	0.54	1.03	1.9	7.7
22K4	48.0	475	431	34,200	5,700	0.40	0.76	2.0	8.0
16K6	48.0	418	269	30,096	5,016	0.63	1.21	2.0	8.1

CASM Bar Joist Selection:

Joist Size:	20K4	Span:	24.0 ft	Spacing:	48 in	Total Ld:	430 plf	Live Ld:	353 plf
Wgt(tons):	0.09	Mmax:	30,960	Rmax:	5,160	TL defl:	0.92 in	LL defl:	0.48 in

NOTES:

1. Bar joist selections based on 1988 SJI Load Tables.
   Edit spreadsheet stajstk.xls to revise selection table.
2. Approximate moment of inertia of the joist in inches^4 is:
   Ij = 26.767 (WLL) (L^3) (10^-6), where WLL = Live Load value in table;
   where L = Span - 0.33 in feet

Widely Spaced Element Analysis: Continuous Beam

Start

Use Loads & Design Tool Palette

Select Second Floor/ Lower Roof Horizontal Structural Plane

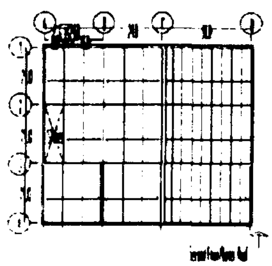
Material Concrete

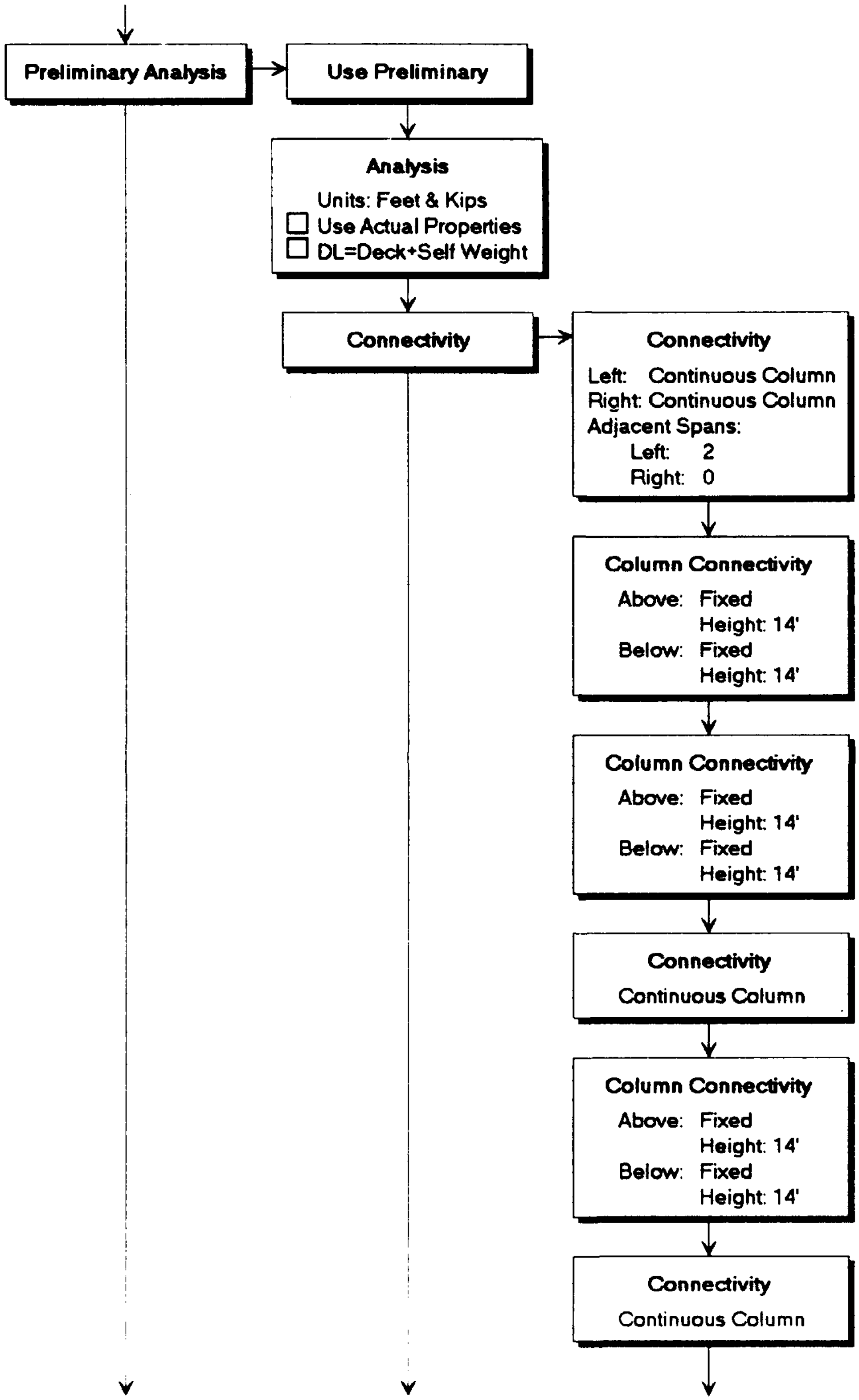
Load Combination 1.4D + 1.7L
☒ Pattern Occupancy Live Load

- Use Load Combination
- Set Factors
  Dead: 1.4
  Live: 1.7
- Add
- OK Button To Close Dialog Window
- Highlight 1.4D+1.7L In List

Select Element To Analyze & Design

- Linear Widely Spaced Beam-C.I.P.
- Select Widely Spaced Element B3-B4
- Review Element Attributes & Guidelines




Preliminary Analysis
Use Preliminary
Analysis
Units: Feet & Kips
Use Actual Properties
DL=Deck+Self Weight
Connectivity
Connectivity
Left: Continuous Column
Right: Continuous Column
Adjacent Spans:
Left: 2
Right: 0
Column Connectivity
Above: Fixed
Height: 14'
Below: Fixed
Height: 14'
Column Connectivity
Above: Fixed
Height: 14'
Below: Fixed
Height: 14'
Connectivity
Continuous Column
Column Connectivity
Above: Fixed
Height: 14'
Below: Fixed
Height: 14'
Connectivity
Continuous Column

Preliminary Analysis

Self Weight

Guidelines

Concrete Beam Estimated Self Weight

◉ Continuous Exterior Spa..
t = 4", h-t = 16", b = 10"
◉ NLWT @ 150 pcf

Close Self Weight Guidelines Dialog Window

Self Weight

Estimated Self Weight: 166.7 plf
☒ Update Area Structure Loads
☒ Add Self Weight

Yes, Draw Pattern Live Loads

Analysis

Analysis File Name: Optional

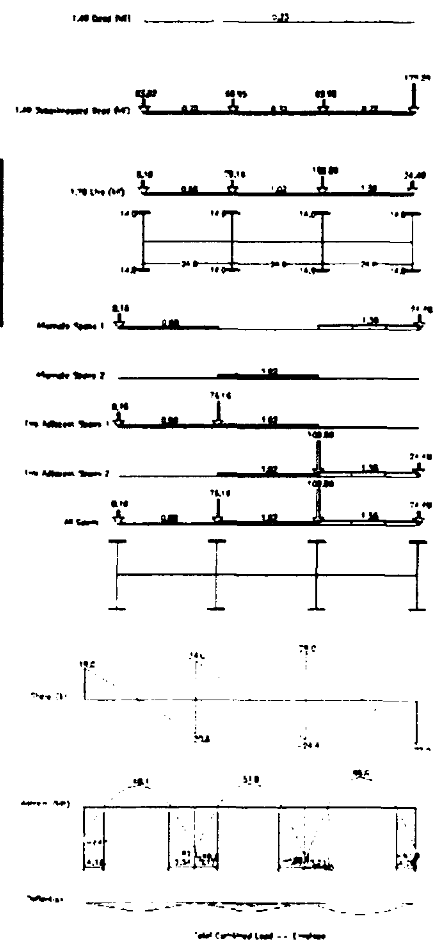
Yes, The Loads & Connectivity Are Correct

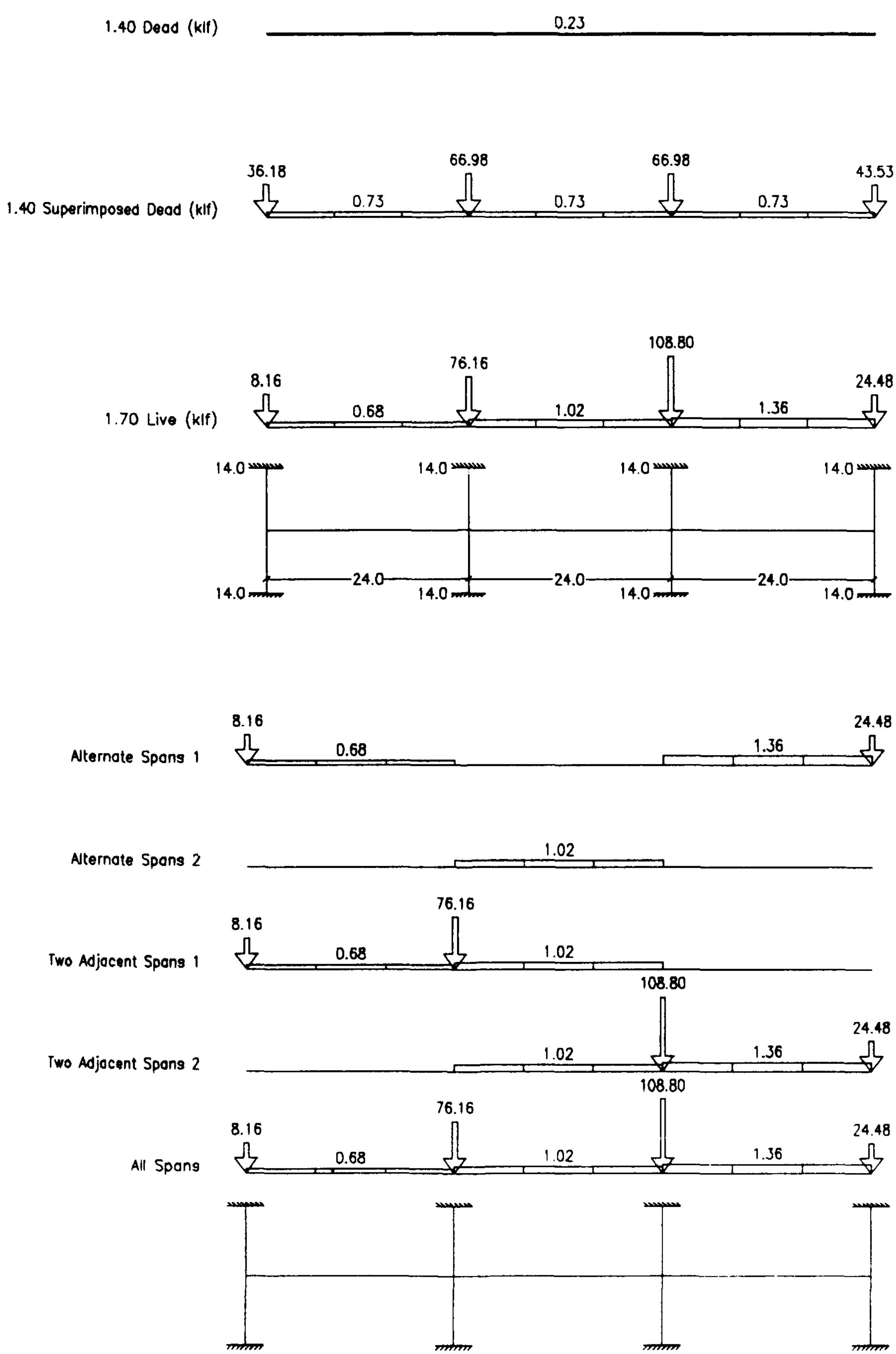
View Shear, Moment & Deflection Diagrams

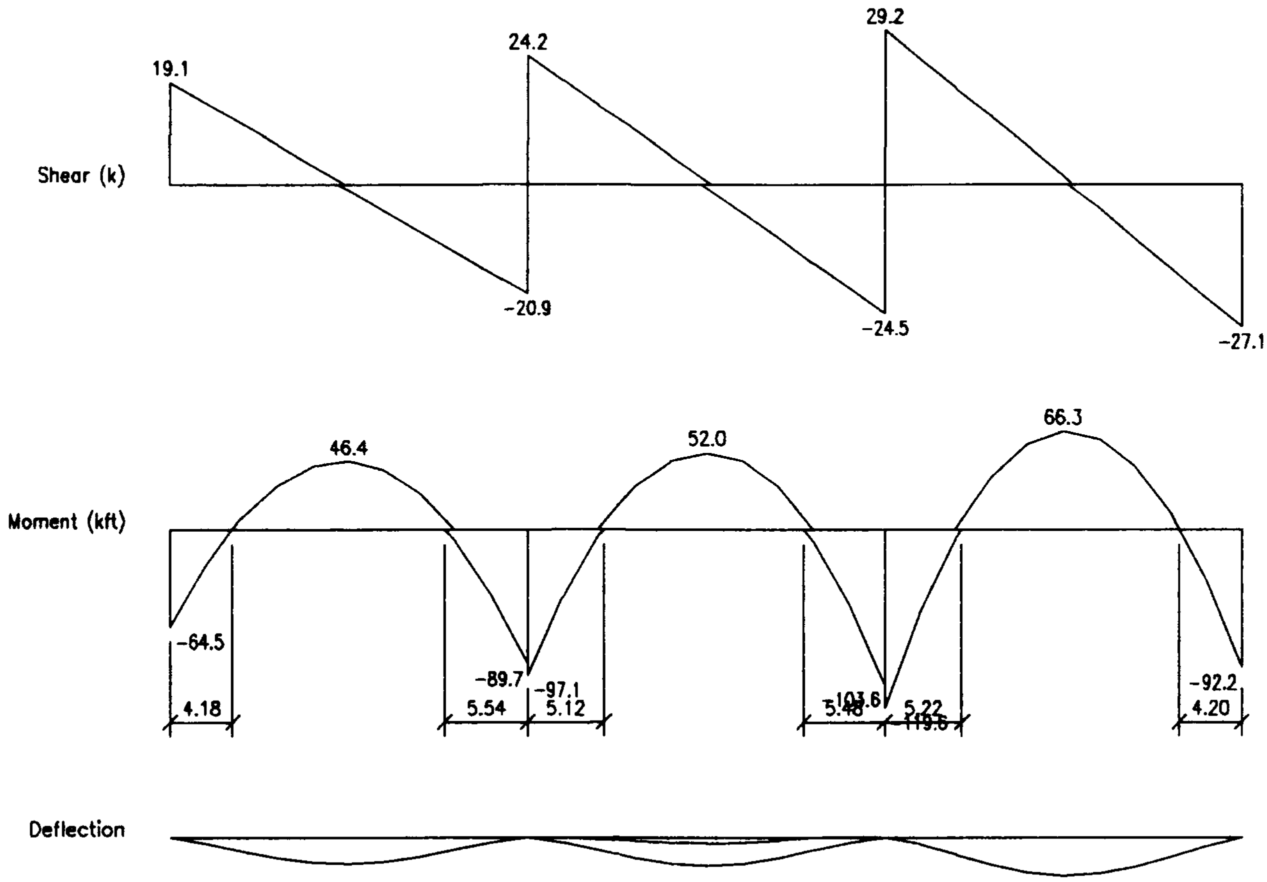
Excel Data

◉ Execute Excel

End

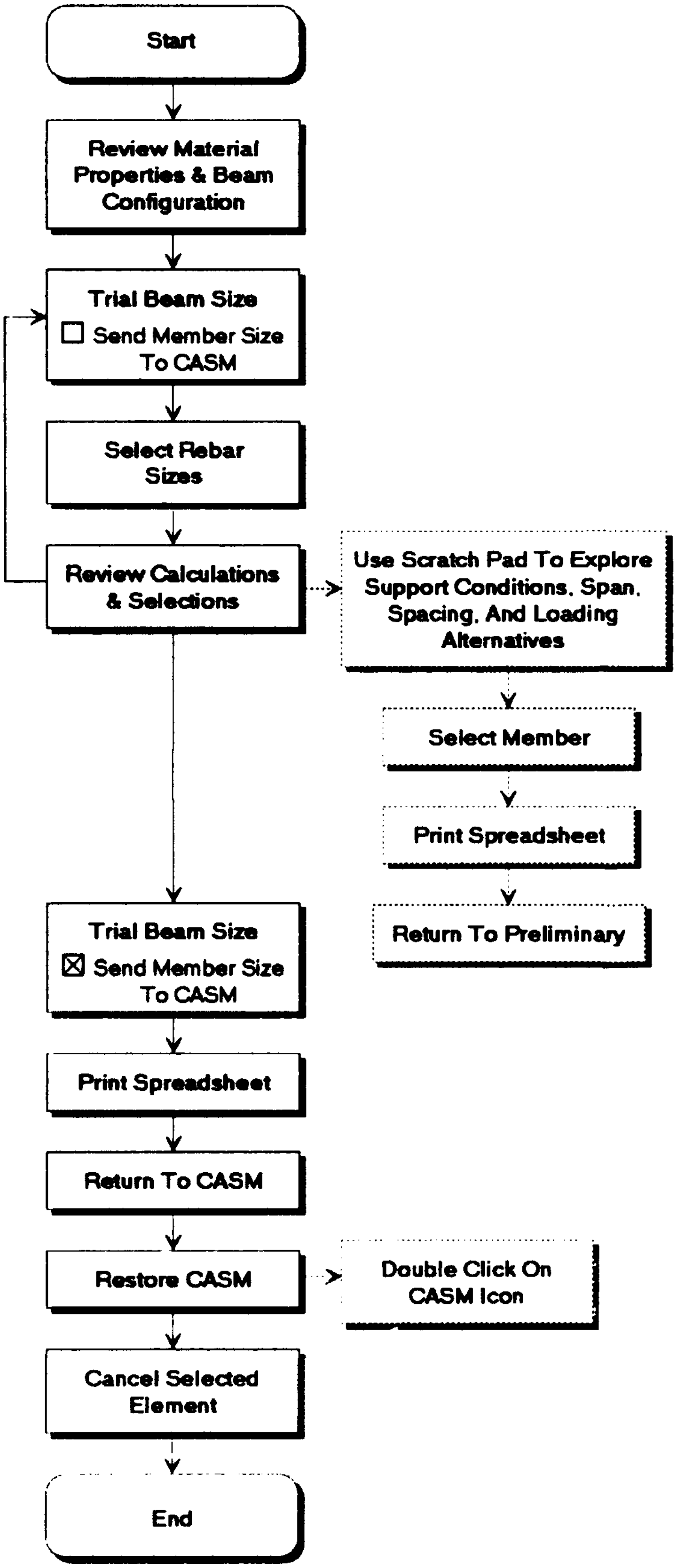



1.40 Dead (klf)
0.23
1.40 Superimposed Dead (klf)
36.18
66.98
66.98
43.53
0.73
0.73
0.73
1.70 Live (klf)
8.16
76.16
108.80
24.48
0.68
1.02
1.36
14.0
14.0
14.0
14.0
24.0
24.0
24.0
14.0
14.0
14.0
14.0
Alternate Spans 1
8.16
0.68
1.36
24.48
Alternate Spans 2
1.02
Two Adjacent Spans 1
8.16
76.16
0.68
1.02
Two Adjacent Spans 2
108.80
24.48
1.02
1.36
All Spans
8.16
76.16
108.80
24.48
0.68
1.02
1.36



Total Combined Load -- Envelope

Concrete Beam Design



Concrete Beam Preliminary Selection

CONCRETE BEAM PRELIMINARY SELECTION

Project: Office Building - Scheme C	**Date: Feb 28, 1992**
Location: Radford AAP	**Engr:**

CASM Load & Analysis Data:

		Load Combination: 1.4D + 1.7L					
Method:	Analysis		Factored Moments (k-ft)			Fact. Reactions	
Member ID:		Load Type	Left	Mid	Right	Left(k)	Right(k)
Connectivity:	Column (Left)						
	Column (Right)	Dead	12.2	6.3	8.8	2.9	2.7
Beam Span:	24.0 ft	Sup Dead	38.1	19.7	27.4	9.2	8.3
Trib Width=	8.0 ft	Live	69.3	37.3	56.1	17.0	16.2
Depth Limit=	36.0 in. max	Lmin Roof					
Concrete F'c=	4.0 ksi	Snow					
Concrete Wt=	145 pcf	Wind					
Steel Fy=	60.0 ksi	Summary	119.6	63.3	92.2	29.2	27.1

CASM Preliminary Beam Dimensions/Values:

ACI Preliminary Dimensions:	T-Beam Data:		Rebar Ratios:	
ACI Depth: L/ 21.0 = 13.7 in	ACI Slab Depth L/24=	4.0 in	pmax=	2.14 %
Width: h/ 1.75= 8.0 in	Selected Slab Depth=	4.0 in	1/2pmax=	1.07 %
Beam Configuration:	Effective Width bE=	72.0 in	pmin=	0.33 %
Rectangular	Stress Blk Depth a(T)=	0.3 in		
Design Data: Bending phi(¢)= 0.90	beta(ß)= 0.85		m= 17.6	Ru= 581 psi

CASM Preliminary Beam Sizes and Reinforcing:

Beam Size	Left end		Midspan		Right end		Shear	Volume	Weight
b x h	As	¢Mn	As	¢Mn	As	¢Mn	Rebars	(c.y.)	(klf)
11 x 14	2.90	120	1.35	63	2.09	92	#3@ 5	0.95	0.16
10 x 16	2.32	120	1.12	63	1.71	92	#3@ 6	0.99	0.16
11 x 18	1.90	120	0.95	63	1.43	92	#3@ 7	1.22	0.20
12 x 20	1.63	120	0.83	63	1.24	92	#3@ 8	1.48	0.24
13 x 22	1.43	120	0.74	63	1.09	92	#3@ 9	1.77	0.29

CASM Preliminary Beam Design:

Beam Configuration:	Trial Depth h= 16.0 in	Cover Top= 1.5 in	d= 13.5 in
Rectangular	Trial Width b= 10.0 in	Cover Btm= 1.5 in	d'= 2.5 in

Bending	Left end			Midspan			Right end		
Reinforcement:	Layers	Reqd	Design	Layers	Reqd	Design	Layers	Reqd	Design
Mu (kf)		120	123		63	75		92	123
Ru (psi)		875	883		463	527		675	883
p (%)		1.61	1.74		0.85	0.96		1.24	1.74
As (sq in.)		2.17	2.37		1.15	1.32		1.68	2.37
Rebar Option:	1	3 - #8		1	4 - #5		1	4 - #6	
Select Rebar:	1	3 - #8		1	3 - #6		1	3 - #8	

Shear			
Reinforcement:	Left End	Right End	Design Values:
Vu:	29.2 kips	27.1 kips	phi(¢)= 0.85
Reqd ¢Vs:	14.7 kips	12.6 kips	¢Vc= 14.5 k
Size&Spacing:	#3 @ 6 in	#3 @ 6 in	½¢Vc= 7.3 k

Properties and Quantities for Concrete Beam/Girder:

Dimensions (b x h): 10 x 16	Volume: 1.0 c.y.	Weight= 0.16 klf	Rebar Wt= .18 tons

Notes:

1. Concrete beam/girder volume and weight does not include slab volume and weight.
2. ACI 318-89 Strength Design used for sizing member.

Truss Element Analysis

Start

Use Loads & Design Tool Palette

Select Second Floor/ Lower Roof Horizontal Structural Plane

Material Steel

Load Combination D + S

Use Load Combination

Set Factors

Dead: 1.0
Snow: 1.0

Add

OK Button To Close Dialog Window

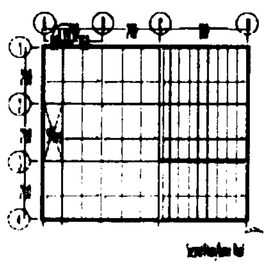
Highlight D+S In List

Select Element To Analyze & Design

Linear Truss-Custom

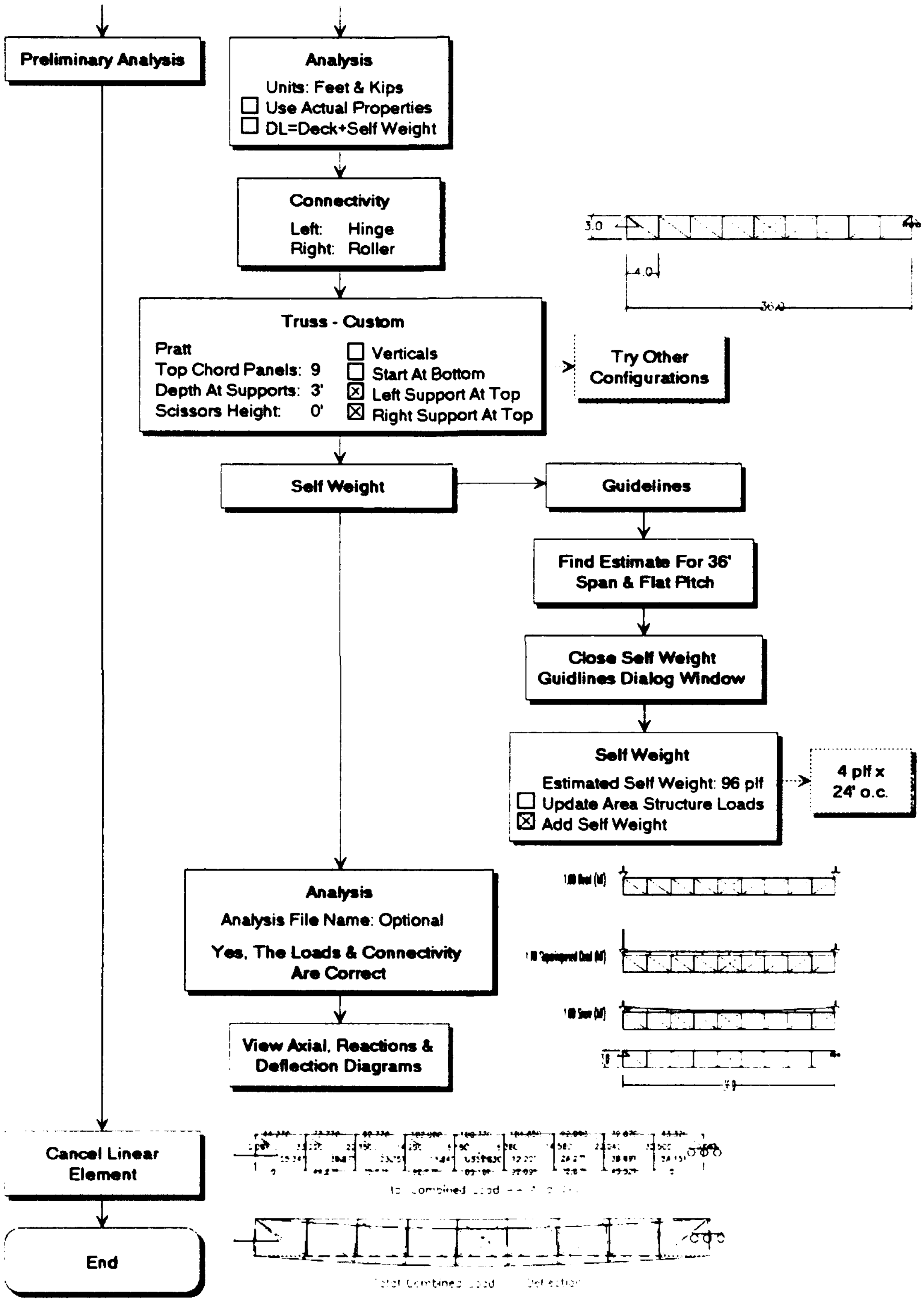
Select A Truss

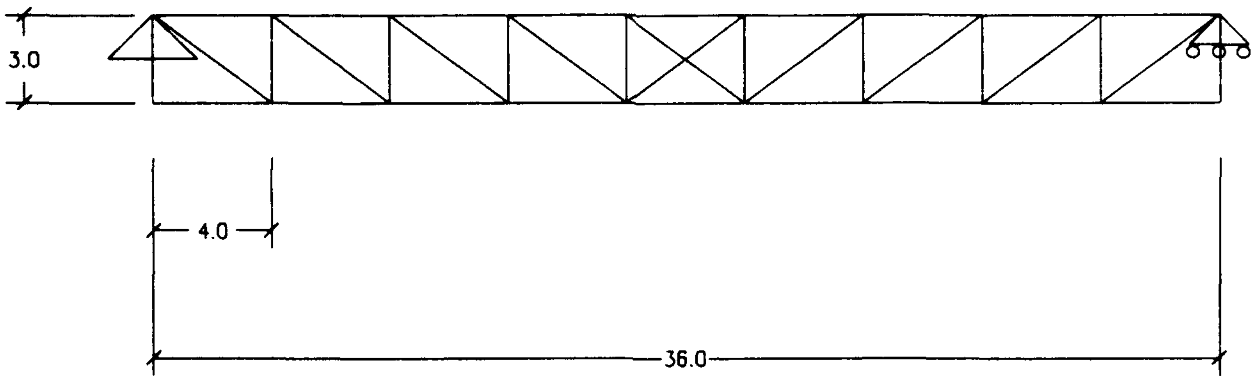
Review Element Attributes & Guidelines

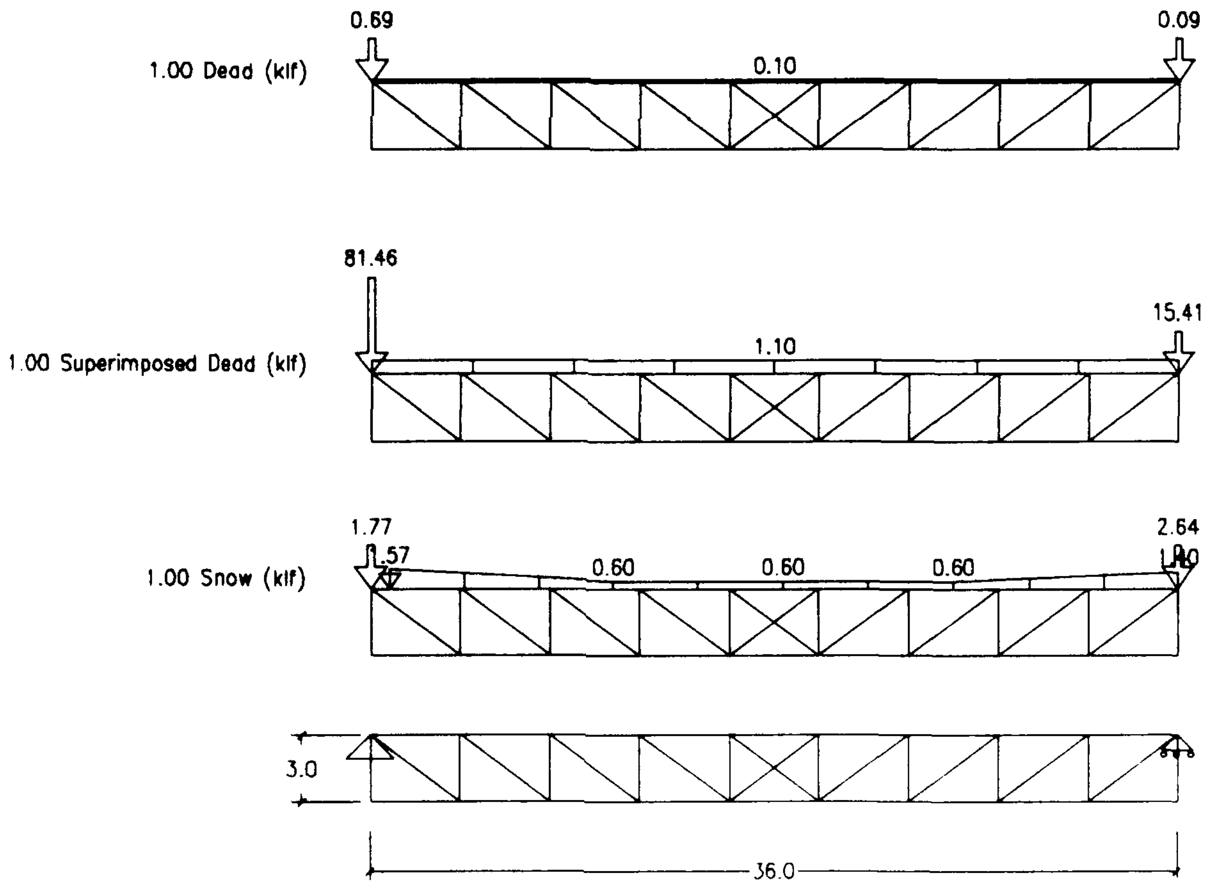


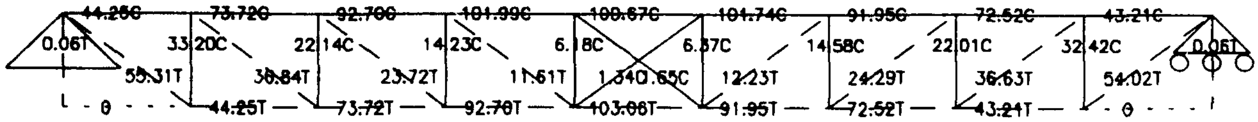
Preliminary Analysis

Use Preliminary

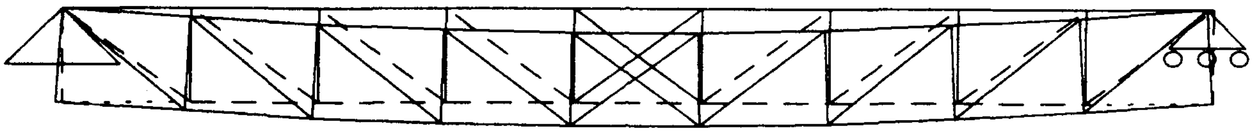

Preliminary Analysis
Analysis
Units: Feet & Kips
Use Actual Properties
DL=Deck+Self Weight
Connectivity
Left: Hinge
Right: Roller
3.0
4.0
36.0
Truss - Custom
Pratt
Top Chord Panels: 9
Depth At Supports: 3'
Scissors Height: 0'
Verticals
Start At Bottom
Left Support At Top
Right Support At Top
Try Other Configurations
Self Weight
Guidelines
Find Estimate For 36' Span & Flat Pitch
Close Self Weight Guidlines Dialog Window
Self Weight
Estimated Self Weight: 96 plf
Update Area Structure Loads
Add Self Weight
4 plf x 24' o.c.
Analysis
Analysis File Name: Optional
Yes, The Loads & Connectivity Are Correct
View Axial, Reactions & Deflection Diagrams
Cancel Linear Element
End


3.0
4.0
36.0

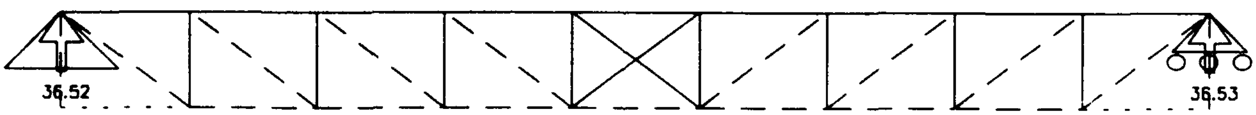

1.00 Dead (klf)
0.69
0.10
0.09
1.00 Superimposed Dead (klf)
81.46
1.10
15.41
1.00 Snow (klf)
1.77
1.57
0.60
0.60
0.60
2.64
3.0
36.0



Total Combined Load -- Axial (k)

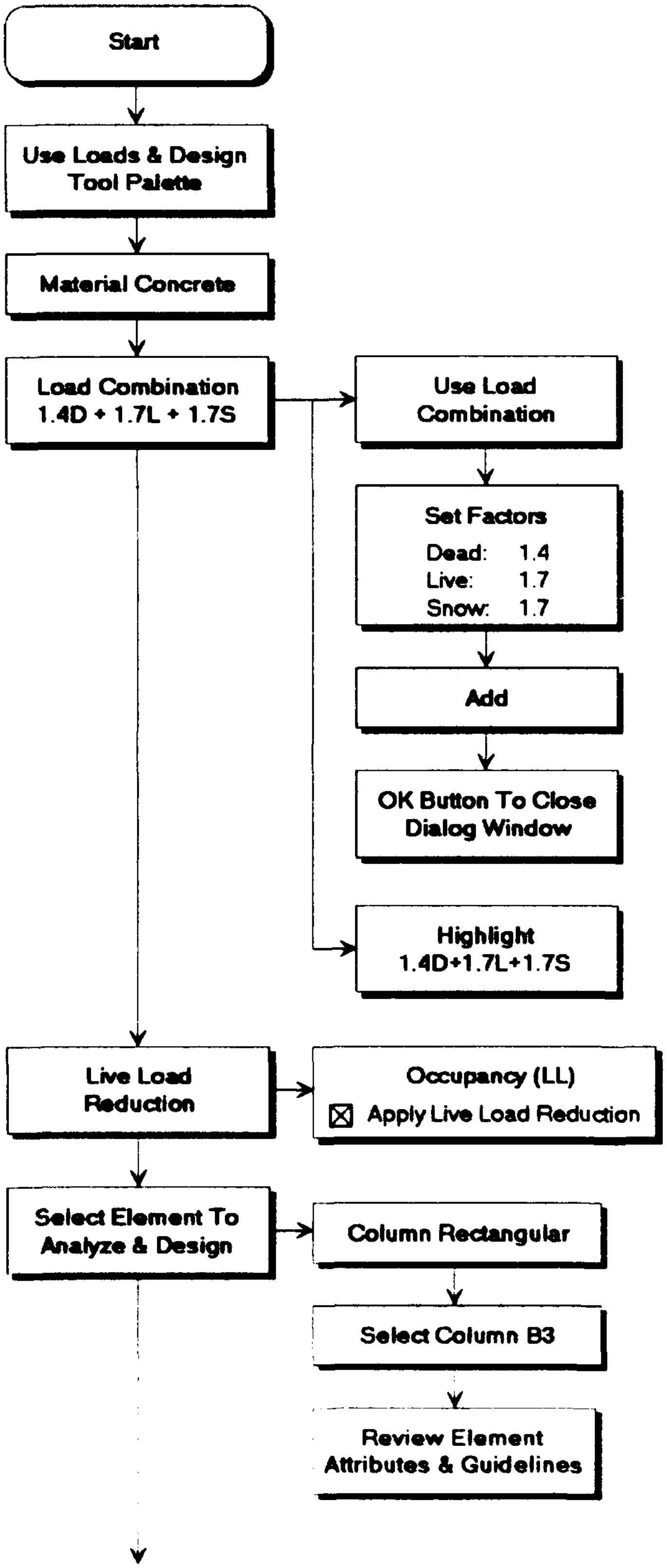


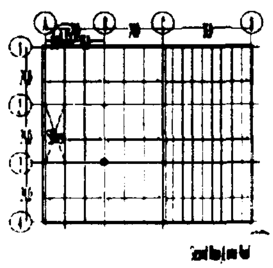
Total Combined Load -- Deflection



Total Combined Load -- Reactions (k)

Column Load Run Down





Preliminary Analysis

Use Preliminary

Analysis

Units: Feet & Kips

☐ Use Actual Properties

☐ DL=Deck+Self Weight

Live Load Reduction

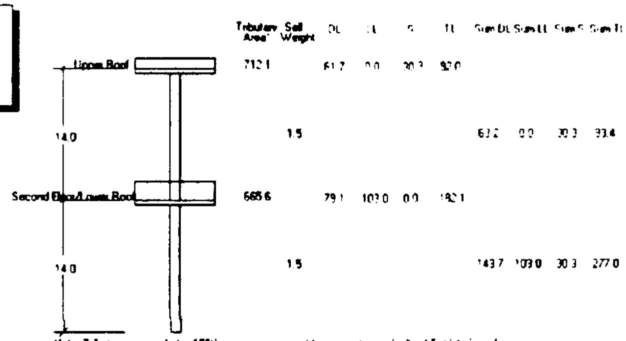
☐ Occupancy Is Public Assembly Or Garage

File Name: Llrout.txt

Self Weight

Estimated Self Weight: 104.2 plf

View Column Load Run Down



Note: Tributary area includes 15% increase to account for concrete continuity at first interior column

Column B 3 Load Run Down (k)

Excel Data

◉ Execute Excel

View Calculations After Design

Print Data

☒ Live Load Reduction

☐ All Other

☒ Print To File

☒ Execute Notepad

Scroll Output

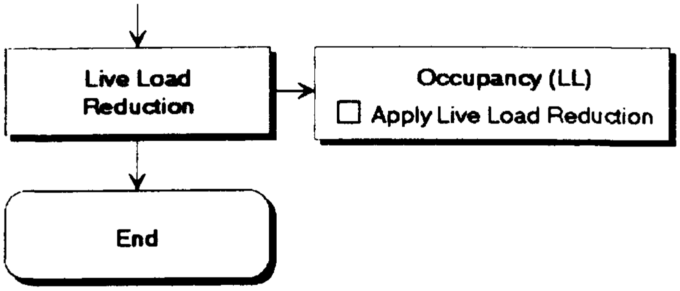
Page Setup

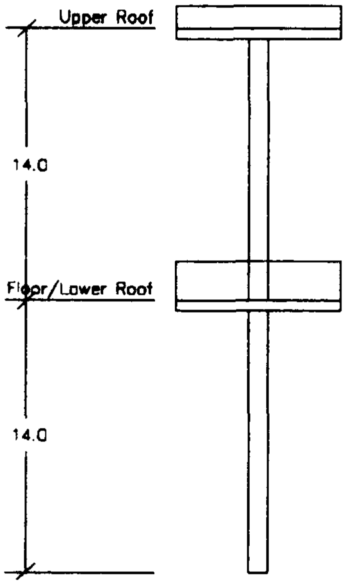
Left Margin: 0.5 in

Right Margin: 0.0 in

Print File

Exit Notepad


Live Load
Reduction
Occupancy (LL)
Apply Live Load Reduction
End



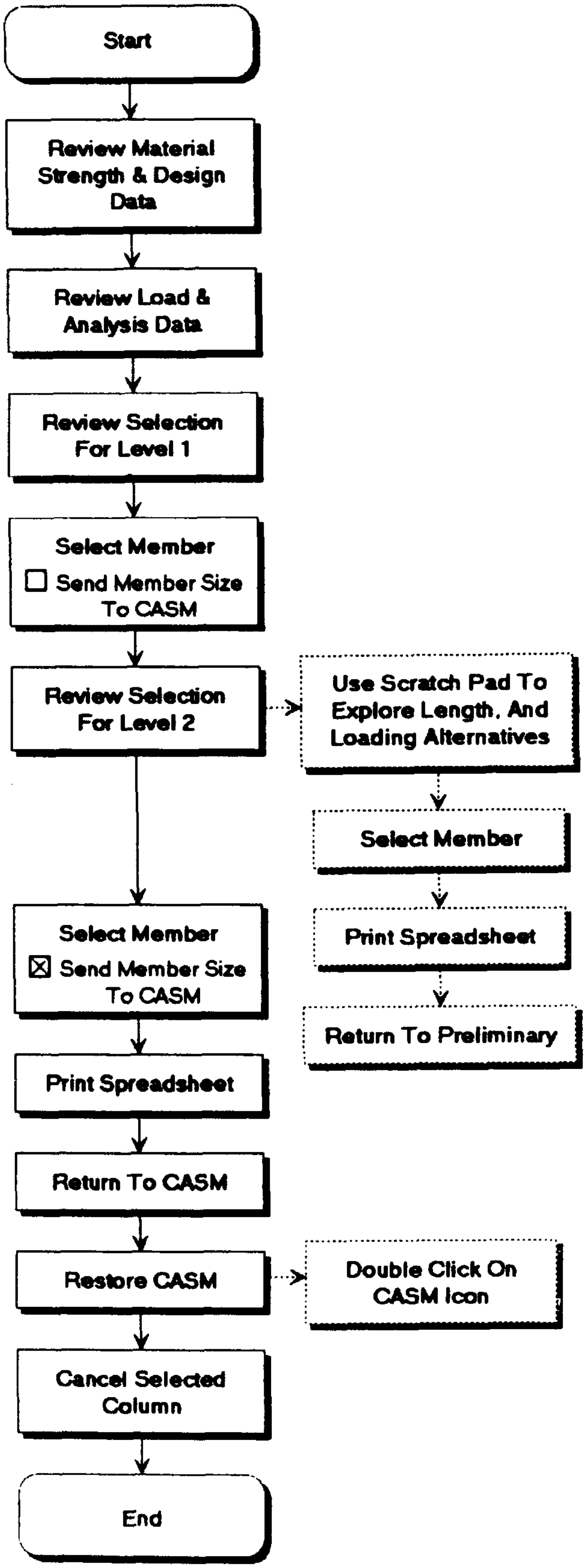
	Tributary Area*	Self Weight	DL	LLR	LLR	S	TL	Sum DL	Sum LLR	Sum S	Sum TL
Upper Roof	712.1		61.7	0.0	0.0	30.3	92.0				
14.0		1.5						63.2	0.0	30.3	93.4
Second Floor/Lower Roof	685.6		80.0		79.2	0.0	159.2				
14.0		1.5						144.6	79.2	30.3	254.1

Note: Tributary area includes 15% increase to account for concrete continuity at first interior column.

Column B-3 Load Run Down (k)

```
Project      : Office Building - Scheme C
Location     : Radford AAP
Design Load  : TM 5-809-1 1991
Time         : Sun Jan 26, 1992  7:38 PM

*************************** Live Load Reduction ***************************

Second Floor/Lower Roof
Office: Offices              (Lo) :   50.0 psf
Tributary area               (TA) :  576.0 sf
Area of influence (Ai) = 4*TA for columns.
Ai = 2304.0 sf
Ai >= 400.0 sf
Lo <= 100.0 psf
L = Lo*[0.25+15/sqrt(Ai)]
L = 28.1 psf
Member supports only one floor.
L >= 0.5*Lo
0.5*Lo = 25.0 psf
+-------------------------+
|     L = 28.13 psf       |
+-------------------------+

*************************** Live Load Reduction ***************************

Second Floor/Lower Roof
Office: Corridor (main)      (Lo) :  100.0 psf
Tributary area               (TA) :  576.0 sf
Area of influence (Ai) = 4*TA for columns.
Ai = 2304.0 sf
Ai >= 400.0 sf
Lo <= 100.0 psf
L = Lo*[0.25+15/sqrt(Ai)]
L = 56.3 psf
Member supports only one floor.
L >= 0.5*Lo
0.5*Lo = 50.0 psf
+-------------------------+
|     L = 56.25 psf       |
+-------------------------+

*************************** Live Load Reduction ***************************

Second Floor/Lower Roof
Office: Files & Storage      (Lo) :  150.0 psf
Tributary area               (TA) :  576.0 sf
Area of influence (Ai) = 4*TA for columns.
Ai = 2304.0 sf
Ai >= 400.0 sf
Lo > 100.0 psf
Member supports only one floor.
No live load reduction taken.
L = Lo
+-------------------------+
|     L = 150.00 psf      |
+-------------------------+
```

Concrete Column Design



Concrete Column Preliminary Selection

CONCRETE COLUMN PRELIMINARY SELECTION

Project: Office Building - Scheme C Location: Radford AAP	Date: Feb 26, 1992 Engr:

CASM Load & Analysis Data:

Method: Analysis Load Combination: 1.4D + 1.7L + Conc F'c= 4.0 ksi

Member ID: B-3 Size Limit= 16.0 in. max Fy= 60.0 ksi

Name	Level	Flr to Flr Ht	Trib Area	Floor Level Area Load (kips) Dead	Live	Lmin	Snow	Wind	Load Totals
	6								
	5								
	4								
	3								
Upper Roof	2	14.00	576	63.2			30.3		93.4
Second Floor/Lo	1	14.00	576	144.6	79.2		30.3		254.1

CASM Column Selection Table

Column Data:		Floor Level	Calculated Values: Ag (in^2)	b (in)	p (%)	Ast (in^2)	Rebar & Size	Pu (k)
Floor Level:	2							
Column Shape:	Square							
Reinf. Ratio:	1.5 %	6						
Ties:	Tied	5						
Fire Rating:	1 Hour(s)	4						
Estimated Ave.		3						
Beam Depth:	20.0 in.	2	111.8	11	0.5	0.56	4- #4	294
Concrete Wgt:	145 pcf	1	111.8	11	1.2	1.30	4- #6	325

CASM Column Design Data:

Level	b (in)	Ag (in^2)	Rebar & Size	Ast (in^2)	p (%)	Pu (kip)	Reqd Pu	Pc (kip)	Tie & Spacing
- 6									
- 5									
- 4									
- 3									
Upper Roof - 2	11	121	4- #4	0.80	0.7	256	93		#3@8
r/Lower Roof - 1	11	121	4- #6	1.76	1.5	286	254		#3@11

Notes:

1. Initial column size based on larger of:
   a. Size based on axial load Ag=Pn/(.8*(.85f'c+p*(fy-.85f'c)))
   b. Size based on fire resistance rating.
   c. Size assuming k=1.0 and neglecting effects of slenderness by solving for b:
      first story - - - - - - - lu/b <= 10
      above first story - lu/b <= 14
2. Slenderness is considered when selecting a column size less than the calculated value.

Lateral Resistance Philosophy

Steps Required

1. Create building volume

2. Define a structural grid

3. Layout structural framing on ALL levels

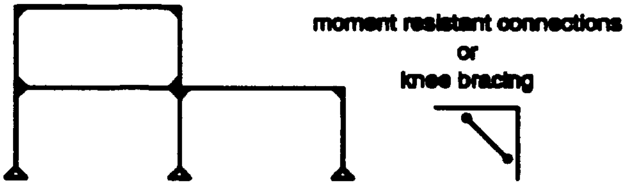
4. Assign gravity load on ALL levels
   Calculate wind and/or seismic loads

5. Select a load combination including wind or seismic loads

6. Define N-S & E-W vertical resistance system

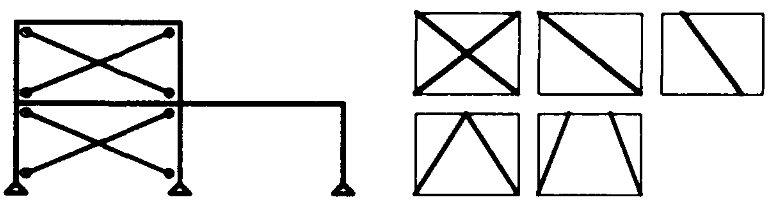
   Options:

   1. Unbraced Frames

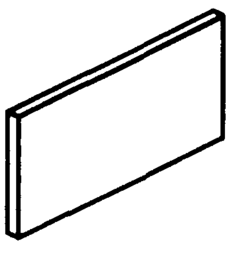


   2. Braced Frames

      A. Trussing



      B. Shear Walls

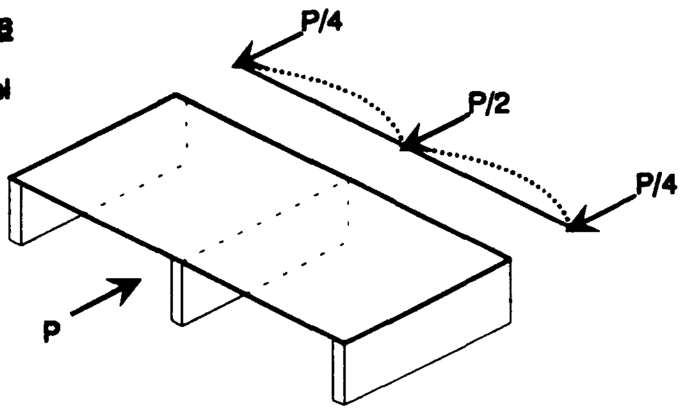


7. Define horizontal diaphragm systems

   All flexible
   All rigid
   Floors rigid & roof flexible

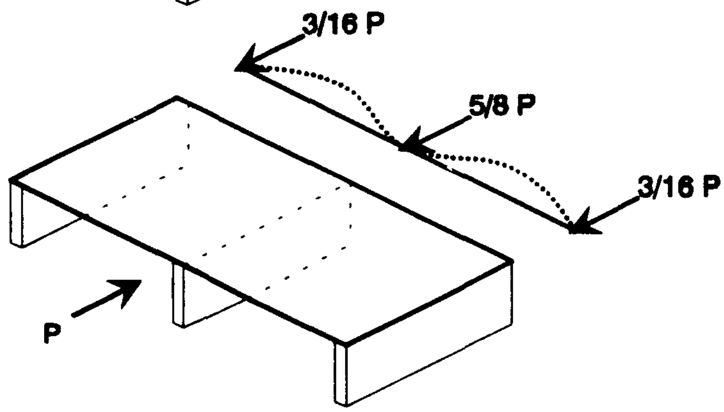
Flexible Diaphragms

Simple Beam Model
(tributary area)



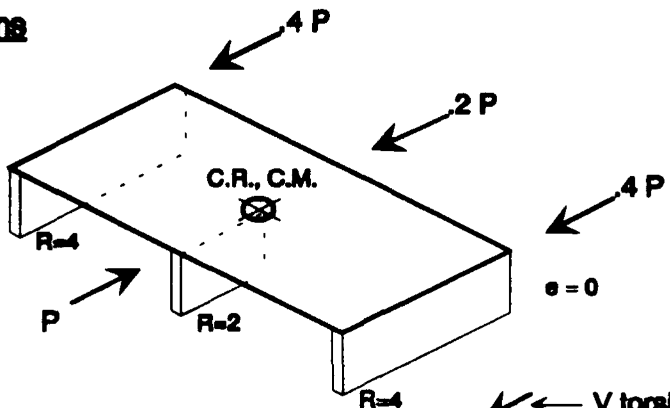
* No Torsion

Continuous Beam Model



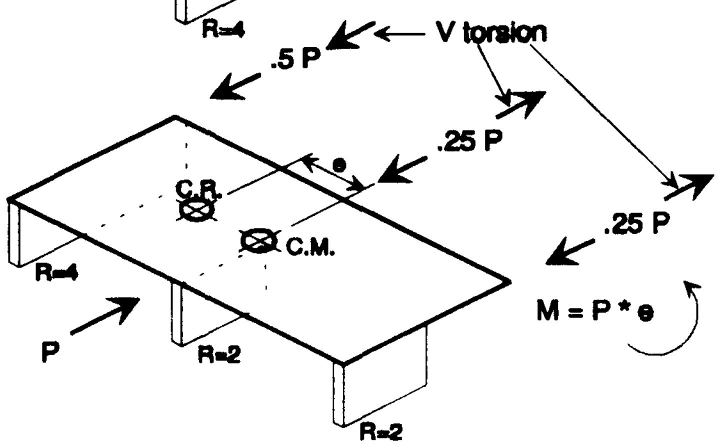
Rigid Diaphragms

Symmetrical

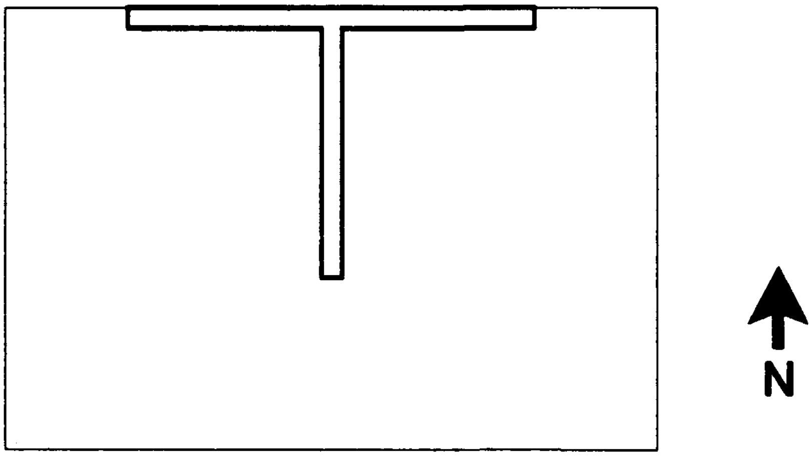


Torsion
(even accidental minimum required)

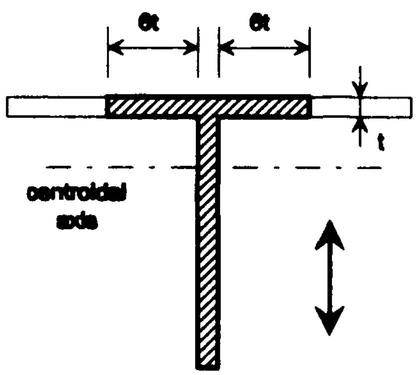
Non-Symmetrical



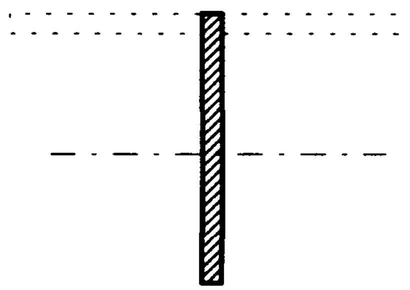
Monolithic Perpendicular Shear Walls



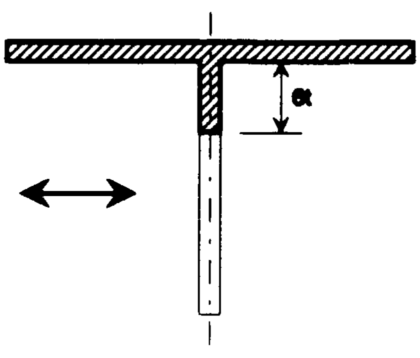
For N-S



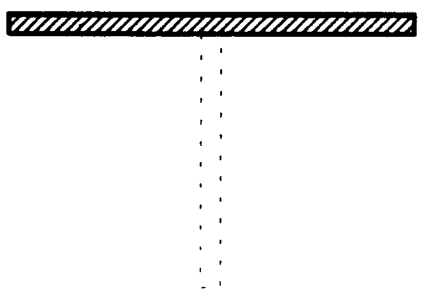
or



For E-W



or



Define Lateral Resistance

Start

Use Draw Structure Tool Palette

Select Second Floor/ Lower Roof Horizontal Structural Plane

Define Second Floor/ Lower Roof Diaphragm Type

Diaphragm Guidlines

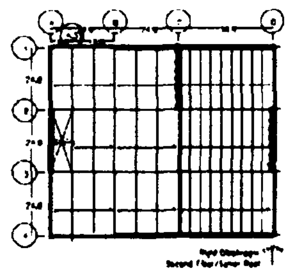
Lateral Horizontal Rigid Diaphragm

Define N-S Lateral Resistance

Define Location

Vertical Define Location

Select Wall On Grid Line A



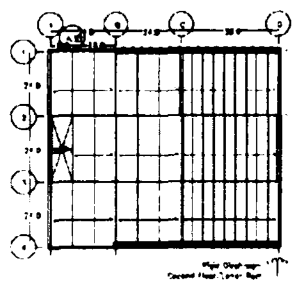
Repeat For Grid Lines C & D

Define E-W Lateral Resistance

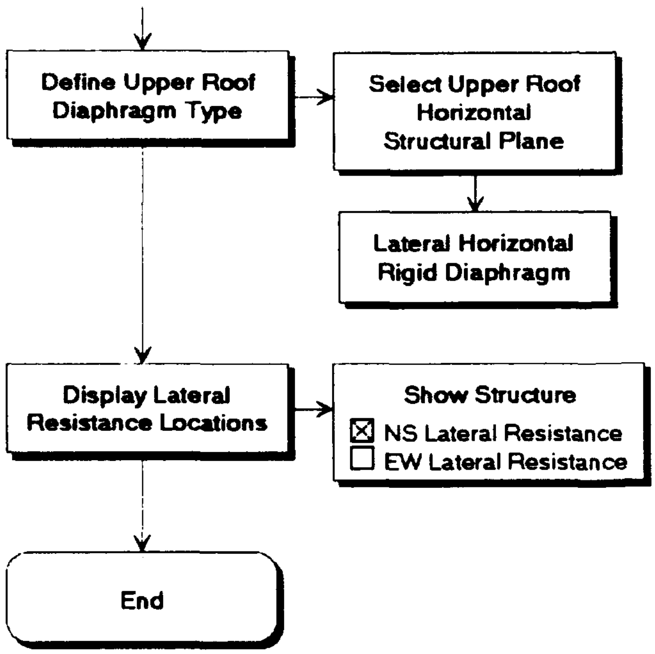
Define Location

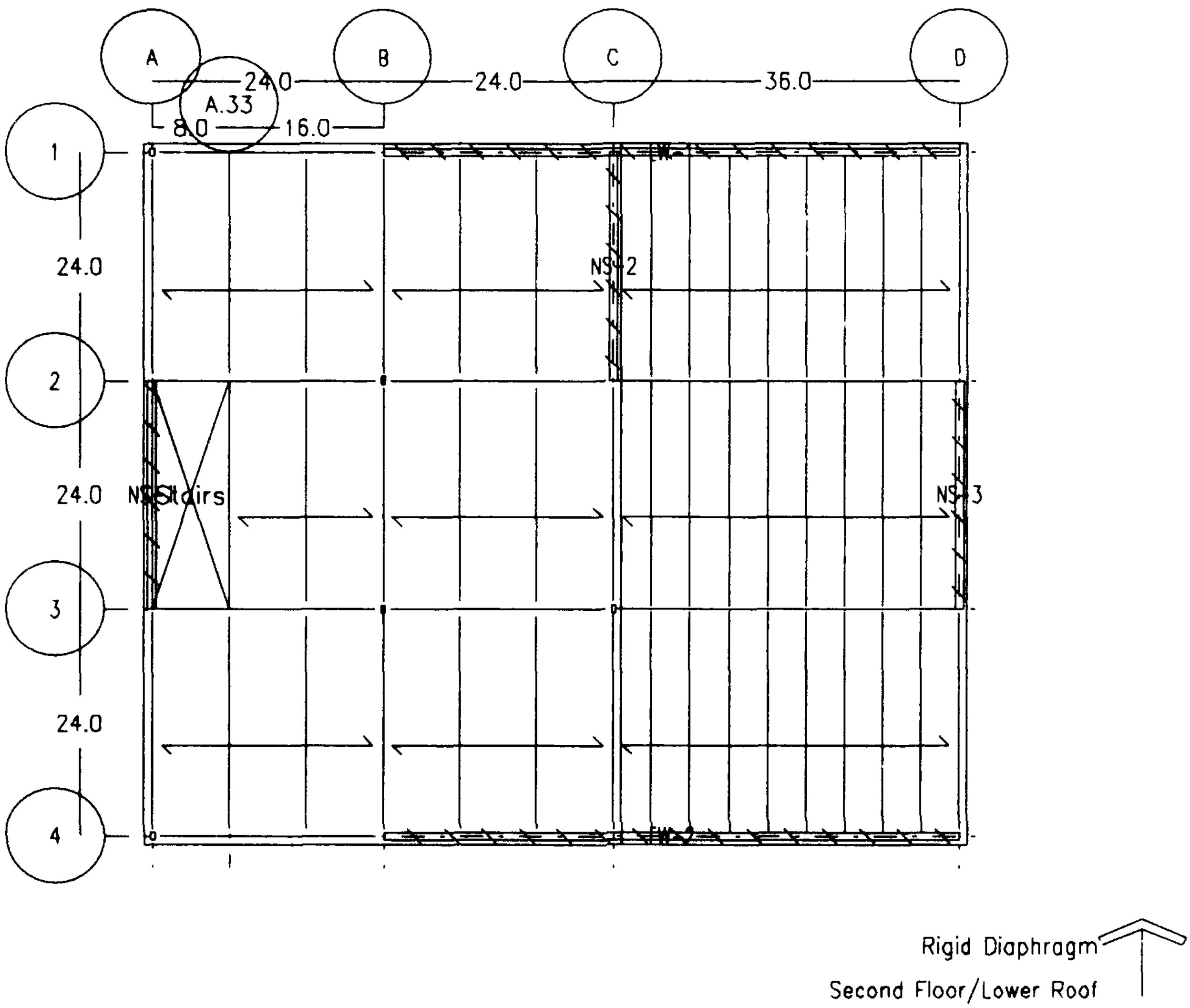
Vertical Define Location

Select Wall On Grid Line 1

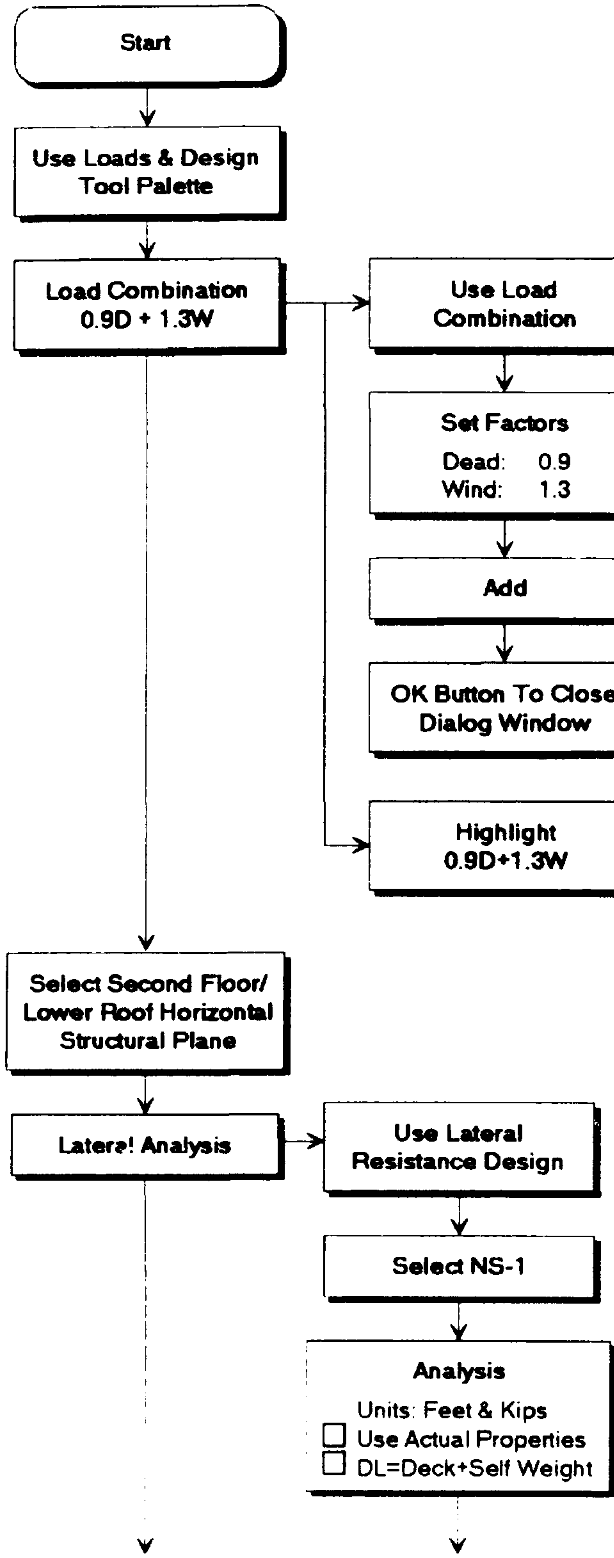


Repeat For Grid Line 4


Define Upper Roof Diaphragm Type
Select Upper Roof Horizontal Structural Plane
Lateral Horizontal Rigid Diaphragm
Display Lateral Resistance Locations
Show Structure
☒ NS Lateral Resistance
☐ EW Lateral Resistance
End


A
B
C
D
24.0
24.0
36.0
A.33
8.0
16.0
1
2
3
4
24.0
24.0
24.0
NS-2
NS-1
Stairs
NS-3
EW-1
EW-2
Rigid Diaphragm
Second Floor/Lower Roof

Wind Lateral Analysis

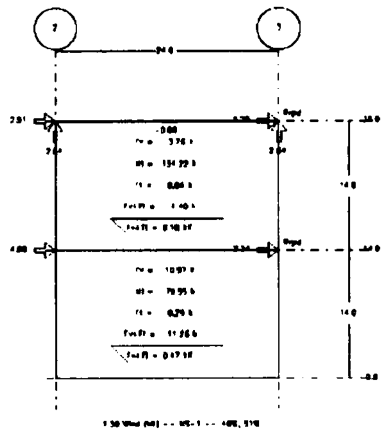


Lateral Analysis

Wind Load Options
Wind Direction: South
When 2 Wind Loads: Max. Suction
Wind Load: GCpi = 0

Rigid Horizontal Diaphragm Calculations
File Name: Rigidout.txt
☒ Consider Perpendicular Wall...

View Loads



View Output

Print Data
☒ Rigid Diaphragm
☐ All Other
☒ Print To File
☒ Execute Notepad

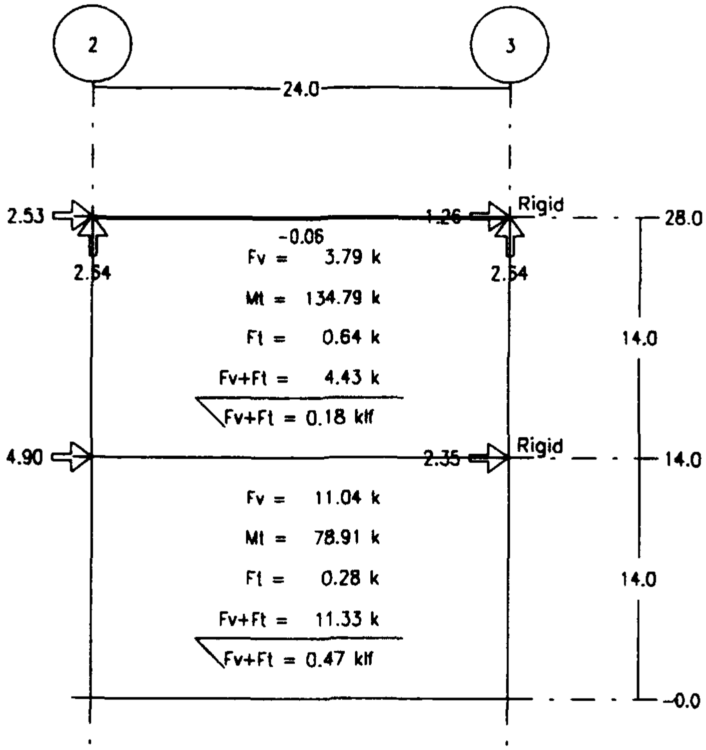
Scroll Output

Page Setup
Left Margin: 0.5 in
Right Margin: 0.0 in

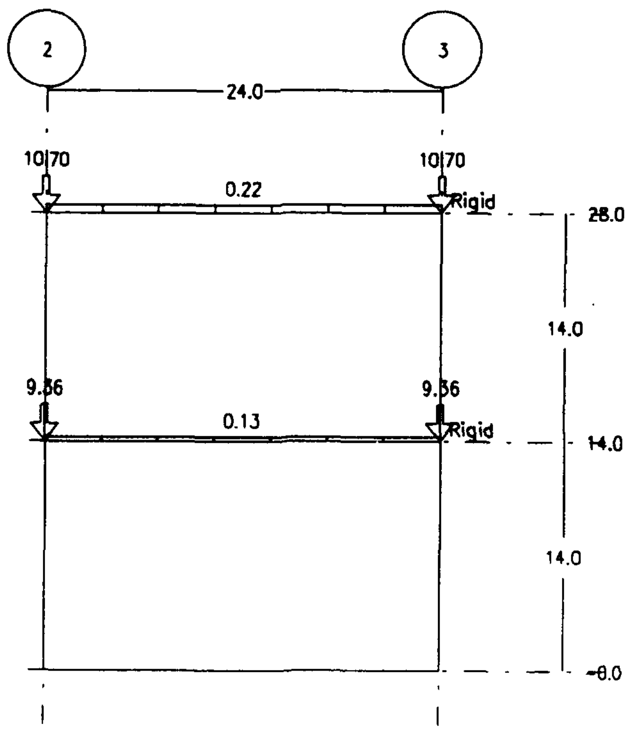
Print File

Exit Notepad

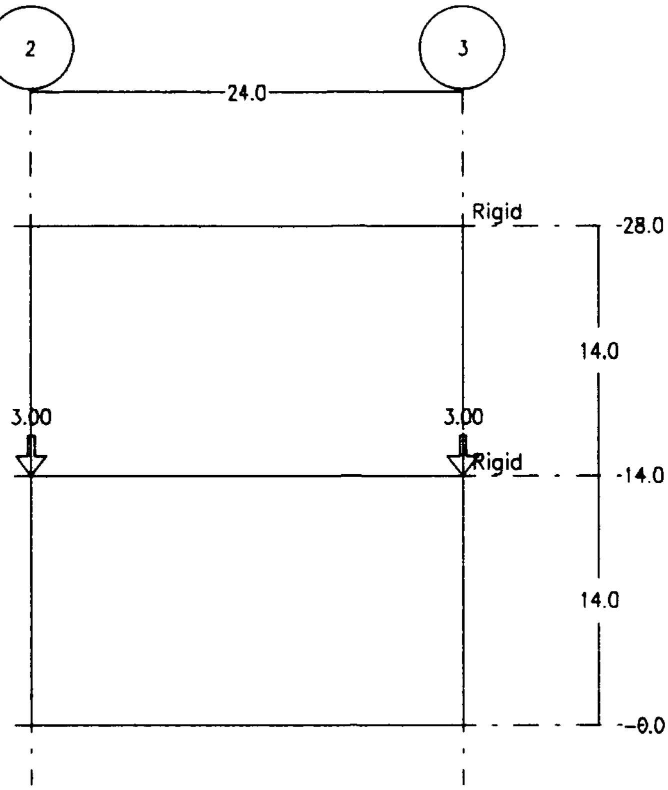
End



1.30 Wind (klf) -- NS-1 -- 46%, 31%



0.90 Superimposed Dead (klf)



0.90 Dead (klf)

Project : Office Building - Scheme C
Location : Radford AAP
Time : Sun Jan 26, 1992 8:15 PM

**************** Rigid Horizontal Diaphragm Calculations ****************

NS-1

Level Height: 14.0 ft

Centroidal Axis

Name	t (ft)	l (ft)	Area (ft^2)	NS Arm (ft)	NS Moment Area (ft^3)	EW Arm (ft)	EW Moment Area (ft^3)
NS-1	0.83	24.00	20.0	12.00	240	0.00	0
Sum			20.0		240		0

Centroid = sum(MomentArea)/sum(Area)
NS Centroid : 12.00 ft EW Centroid : 0.00 ft
Av : 20.00 sqft

Moment of Inertia

Name	b (ft)	h (ft)	bh^3/12 (ft^4)	Area (ft^2)	d (ft)	Ad^2 (ft^4)	I+Ad^2 (ft^4)
NS-1	0.83	24.00	960	20.0	0.00	0	960
Sum							960

Deflection : 0.254 in Height : 14.0 ft
Total Deflection : 0.254 in

Level Height: 28.0 ft

Same As Previous Level

NS Centroid : 12.00 ft EW Centroid : 0.00 ft
Av : 20.00 sqft Moment of Inertia: 960 ft^4
Deflection : 0.254 in Height : 14.0 ft
Total Deflection : 0.509 in

NS-2

Level Height: 14.0 ft

Centroidal Axis

Name	t (ft)	l (ft)	Area (ft^2)	NS Arm (ft)	NS Moment Area (ft^3)	EW Arm (ft)	EW Moment Area (ft^3)
NS-2	0.83	24.42	20.3	12.21	248	0.00	0
EW-1	0.83	5.00	4.2	24.00	100	-2.92	-12
EW-1	0.83	5.00	4.2	24.00	100	2.92	12
Sum			28.7		448		0

Centroid = sum(MomentArea)/sum(Area)
NS Centroid : 15.63 ft EW Centroid : 0.00 ft
Av : 20.35 sqft

Moment of Inertia

Name	b (ft)	h (ft)	bh^3/ 12 (ft^4)	Area (ft^2)	d (ft)	Ad^2 (ft^4)	I+Ad^2 (ft^4)
NS-2	0.83	24.42	1011	20.3	-3.43	239	1250
EW-1	5.00	0.83	0	4.2	8.37	292	292
EW-1	5.00	0.83	0	4.2	8.37	292	292
Sum							1833

Deflection : 0.214 in Height : 14.0 ft
Total Deflection : 0.214 in

Level Height: 28.0 ft

Centroidal Axis

Name	t (ft)	l (ft)	Area (ft^2)	NS Arm (ft)	NS Moment Area (ft^3)	EW Arm (ft)	EW Moment Area (ft^3)
NS-2	0.83	24.42	20.3	12.21	248	0.00	0
EW-1	0.83	5.00	4.2	24.00	100	-2.92	-12
Sum			24.5		348		-12

Centroid = sum(MomentArea)/sum(Area)
NS Centroid : 14.21 ft EW Centroid : -0.50 ft
Av : 20.35 sqft

Moment of Inertia

Name	b (ft)	h (ft)	bh^3/ 12 (ft^4)	Area (ft^2)	d (ft)	Ad^2 (ft^4)	I+Ad^2 (ft^4)
NS-2	0.83	24.42	1011	20.3	-2.00	82	1093
EW-1	5.00	0.83	0	4.2	9.79	399	399
Sum							1492

Deflection : 0.223 in Height : 14.0 ft
Total Deflection : 0.437 in

NS-3

Level Height: 14.0 ft

Centroidal Axis

Name	t (ft)	l (ft)	Area (ft^2)	NS Arm (ft)	NS Moment Area (ft^3)	EW Arm (ft)	EW Moment Area (ft^3)
NS-3	0.83	24.00	20.0	12.00	240	0.00	0
Sum			20.0		240		0

Centroid = sum(MomentArea)/sum(Area)
NS Centroid : 12.00 ft EW Centroid : 0.00 ft
Av : 20.00 sqft

Moment of Inertia

Name	b (ft)	h (ft)	bh^3/ 12 (ft^4)	Area (ft^2)	d (ft)	Ad^2 (ft^4)	I+Ad^2 (ft^4)
NS-3	0.83	24.00	960	20.0	0.00	0	960
Sum							960

Deflection : 0.254 in Height : 14.0 ft
Total Deflection : 0.254 in

EW-1

Level Height: 14.0 ft

Centroidal Axis

Name	t (ft)	l (ft)	Area (ft^2)	NS Arm (ft)	NS Moment Area (ft^3)	EW Arm (ft)	EW Moment Area (ft^3)
EW-1	0.83	60.00	50.0	0.00	0	30.00	1500
NS-2	0.83	5.00	4.2	-2.92	-12	24.00	100
Sum			54.2		-12		1600

Centroid = sum(MomentArea)/sum(Area)
NS Centroid : -0.22 ft EW Centroid : 29.54 ft
Av : 50.00 sqft

Moment of Inertia

Name	b (ft)	h (ft)	bh^3/ 12 (ft^4)	Area (ft^2)	d (ft)	Ad^2 (ft^4)	I+Ad^2 (ft^4)
EW-1	0.83	60.00	15000	50.0	0.46	11	15011
NS-2	5.00	0.83	0	4.2	-5.54	128	128
Sum							15139

Deflection : 0.075 in Height : 14.0 ft
Total Deflection : 0.075 in

Level Height: 28.0 ft

Centroidal Axis

Name	t (ft)	l (ft)	Area (ft^2)	NS Arm (ft)	NS Moment Area (ft^3)	EW Arm (ft)	EW Moment Area (ft^3)
EW-1	0.83	24.42	20.3	0.00	0	12.21	248
NS-2	0.83	5.00	4.2	-2.92	-12	24.00	100
Sum			24.5		-12		348

Centroid = sum(MomentArea)/sum(Area)
NS Centroid : -0.50 ft EW Centroid : 14.21 ft
Av : 20.35 sqft

Moment of Inertia

Name	b (ft)	h (ft)	bh^3/12 (ft^4)	Area (ft^2)	d (ft)	Ad^2 (ft^4)	I+Ad^2 (ft^4)
EW-1	0.83	24.42	1011	20.3	-2.00	82	1093
NS-2	5.00	0.83	0	4.2	9.79	399	399
Sum							1492

Deflection : 0.223 in Height : 14.0 ft
Total Deflection : 0.298 in

EW-2

Level Height: 14.0 ft

Centroidal Axis

Name	t (ft)	l (ft)	Area (ft^2)	NS Arm (ft)	NS Moment Area (ft^3)	EW Arm (ft)	EW Moment Area (ft^3)
EW-2	0.83	60.00	50.0	0.00	0	30.00	1500
Sum			50.0		0		1500

Centroid = sum(MomentArea)/sum(Area)
NS Centroid : 0.00 ft EW Centroid : 30.00 ft
Av : 50.00 sqft

Moment of Inertia

Name	b (ft)	h (ft)	bh^3/12 (ft^4)	Area (ft^2)	d (ft)	Ad^2 (ft^4)	I+Ad^2 (ft^4)
EW-2	0.83	60.00	15000	50.0	0.00	0	15000
Sum							15000

Deflection : 0.075 in Height : 14.0 ft
Total Deflection : 0.075 in

Level Height: 28.0 ft

Centroidal Axis

Name	t (ft)	l (ft)	Area (ft^2)	NS Arm (ft)	NS Moment Area (ft^3)	EW Arm (ft)	EW Moment Area (ft^3)
EW-2	0.83	24.00	20.0	0.00	0	12.00	240
Sum			20.0		0		240

Centroid = sum(MomentArea)/sum(Area)
NS Centroid : 0.00 ft EW Centroid : 12.00 ft
Av : 20.00 sqft

Moment of Inertia

Name	b (ft)	h (ft)	bh^3/12 (ft^4)	Area (ft^2)	d (ft)	Ad^2 (ft^4)	I+Ad^2 (ft^4)
EW-2	0.83	24.00	960	20.0	0.00	0	960
Sum							960

Deflection : 0.254 in Height : 14.0 ft
Total Deflection : 0.329 in

Center of Rigidity

Name	h (ft)	I (ft^4)	Av (ft^2)	Deflection (in)	Rigidity	R/sum(R)	x (ft)	R*x
NS-1	14.0	960	20	0.254	3.931	31.34%	0.8	3.276
NS-2	14.0	1833	20	0.214	4.682	37.33%	48.8	228.633
NS-3	14.0	960	20	0.254	3.931	31.34%	84.8	333.467
Sum					12.544			565.376

Centroid from lower left = sum(R*x)/sum(R) : 45.07 ft
Center of mass from lower left : 39.07 ft
Eccentricity (e) : 6.00 ft
Maximum dimension : 85.67 ft
e min = 0.05*max. dimension : 4.28 ft
Eccentricity (e) used for torsional analysis : 6.00 ft

Name	h (ft)	I (ft^4)	Av (ft^2)	Deflection (in)	Rigidity	R/sum(R)	x (ft)	R*x
NS-1	28.0	960	20	0.509	1.965	46.19%	0.8	1.638
NS-2	28.0	1492	20	0.437	2.290	53.81%	48.3	110.691
NS-3	28.0	0	0	0.000	0.000	0.00%	41.8	0.000
Sum					4.255			112.329

Centroid from lower left = sum(R*x)/sum(R) : 26.40 ft
Center of mass from lower left : 24.11 ft
Eccentricity (e) : 2.29 ft
Maximum dimension : 85.67 ft
e min = 0.05*max. dimension : 4.28 ft
Eccentricity (e) used for torsional analysis : 4.28 ft

Name	h (ft)	I (ft^4)	Av (ft^2)	Deflection (in)	Rigidity	R/sum(R)	x (ft)	R*x
EW-1	14.0	15139	50	0.075	13.327	50.02%	72.6	967.669
EW-2	14.0	15000	50	0.075	13.319	49.98%	0.8	11.099
Sum					26.646			978.768

Centroid from lower left = sum(R*x)/sum(R) : 36.73 ft
Center of mass from lower left : 36.53 ft
Eccentricity (e) : 0.20 ft
Maximum dimension : 73.67 ft
e min = 0.05*max. dimension : 3.68 ft
Eccentricity (e) used for torsional analysis : 3.68 ft

Name	h (ft)	I (ft^4)	Av (ft^2)	Deflection (in)	Rigidity	R/ sum(R)	x (ft)	R*x
EW-3	28.0	1492	20	0.298	3.354	52.50%	72.3	242.633
EW-4	28.0	960	20	0.329	3.035	47.50%	0.8	2.529
Sum					6.389			245.162

Centroid from lower left = sum(R*x)/sum(R) : 38.37 ft
Center of mass from lower left : 36.11 ft
Eccentricity (e) : 2.26 ft
Maximum dimension : 73.67 ft
e min = 0.05*max. dimension : 3.68 ft
Eccentricity (e) used for torsional analysis : 3.68 ft

Assumptions used:

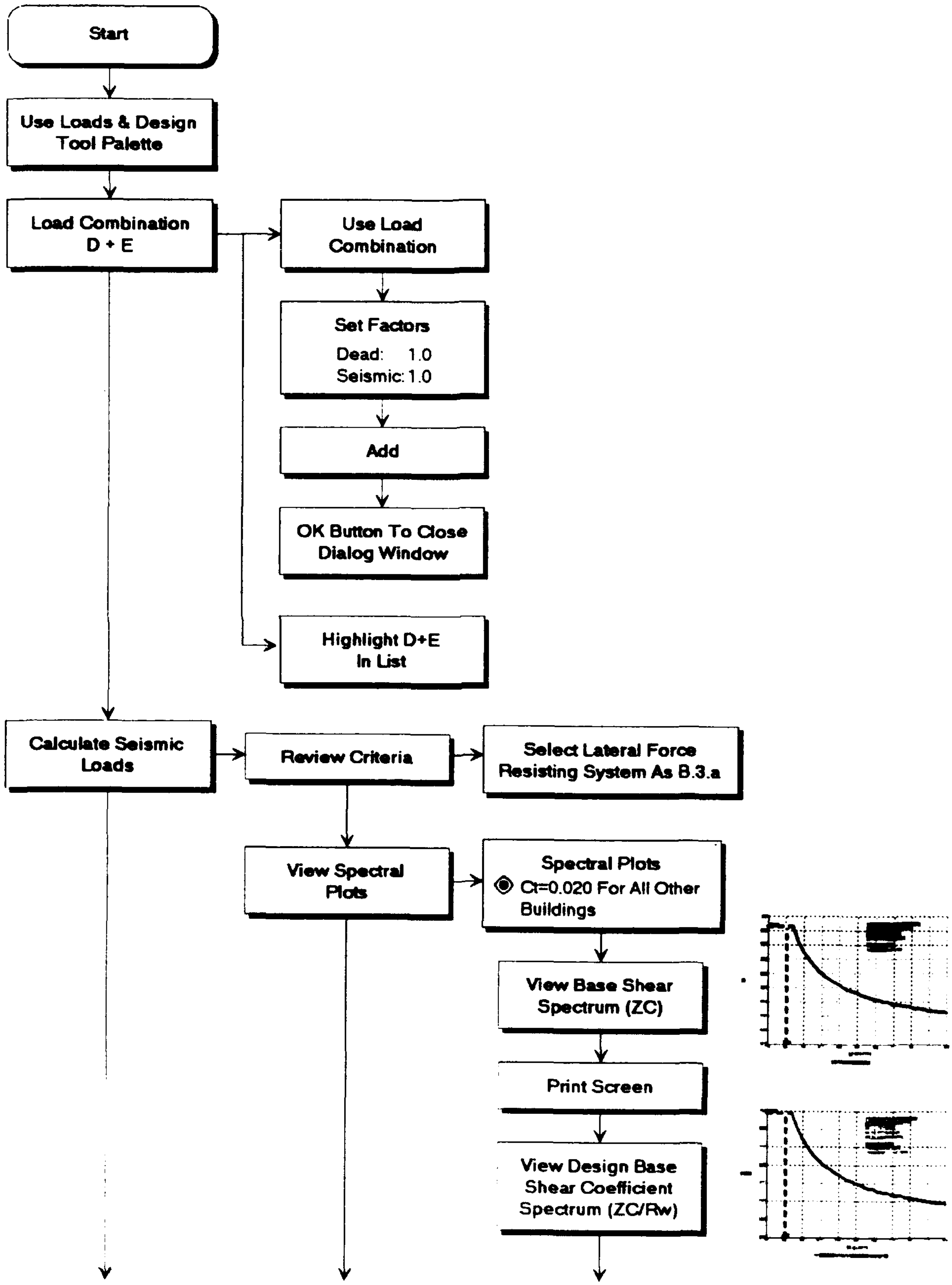
- Em = 144,000 ksf
- Ev = 0.4*Em = 57,600 ksf
- All wall thicknesses are equal.
- Deflections calculated by applying a 1,000 kip load.
- Interstory shear wall deflection is calculated based on cantilever action. Deflection at a level is obtained by summing each story's cantilever deflection from grade.
- Deflection = P*(h^3)/(3*Em*I)+(1.2*P*h)/(A*Ev)
  - h = floor to floor height

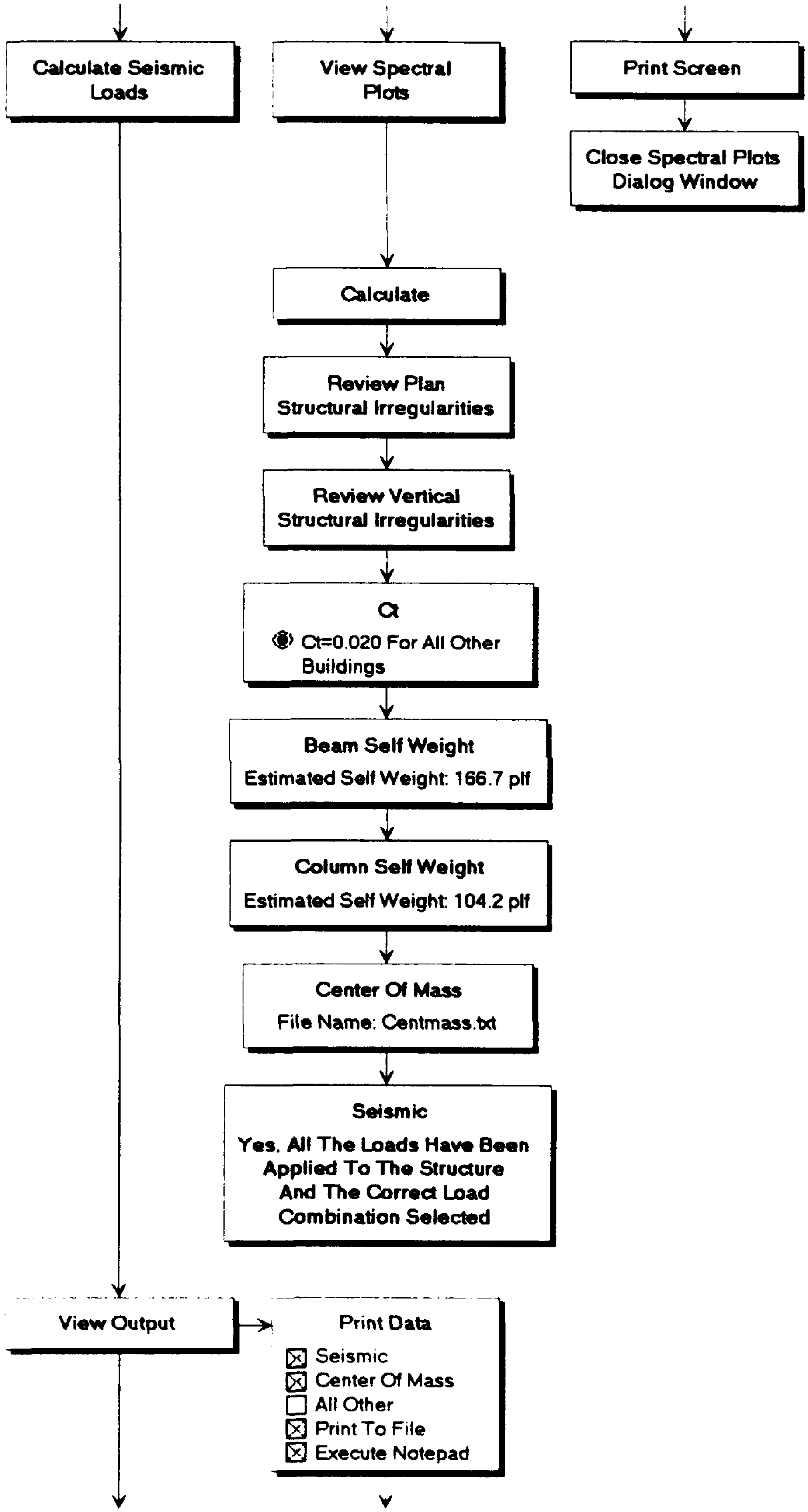
Name	h (ft)	Rigidity	dx (ft)	R*dx	R*dx*dx	R*dx/ sum(R*dx*dx)
NS-1	14.0	3.931	44.2	173.899	7693.191	0.00360
NS-2	14.0	4.682	3.8	17.606	66.208	0.00036
NS-3	14.0	3.931	39.8	156.292	6214.263	0.00324
EW-1	14.0	13.327	35.9	478.133	17153.838	0.00990
EW-2	14.0	13.319	35.9	478.133	17164.481	0.00990
Sum					48291.982	

Name	h (ft)	Rigidity	dx (ft)	R*dx	R*dx*dx	R*dx/ sum(R*dx*dx)
NS-1	28.0	1.963	25.6	50.243	1284.395	0.00477
NS-2	28.0	2.290	21.9	50.243	1102.371	0.00477
NS-3	28.0	0.000	15.4	0.000	0.000	0.00000
EW-1	28.0	3.354	34.0	113.930	3869.819	0.01082
EW-2	28.0	3.035	37.5	113.930	4276.657	0.01082
Sum					10533.242	

Shear distribution : Fv = V*R/sum(R)
Torsional moment : Mt = V*e
Torsional component : Ft = Mt*R*dx/sum(R*dx*dx)
Total shear to element: Ftotal = Fv + Ft

Seismic Loads

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Print Screen
Close Spectral Plots Dialog Window
Calculate
Review Plan Structural Irregularities
Review Vertical Structural Irregularities
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Beam Self Weight
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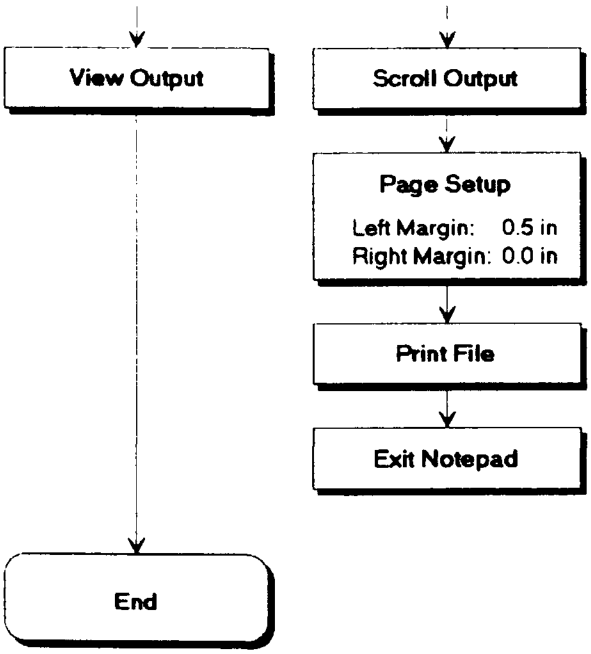
Column Self Weight
Estimated Self Weight: 104.2 plf
Center Of Mass
File Name: Centmass.txt
Seismic
Yes, All The Loads Have Been Applied To The Structure And The Correct Load Combination Selected
View Output
Print Data
Seismic
Center Of Mass
All Other
Print To File
Execute Notepad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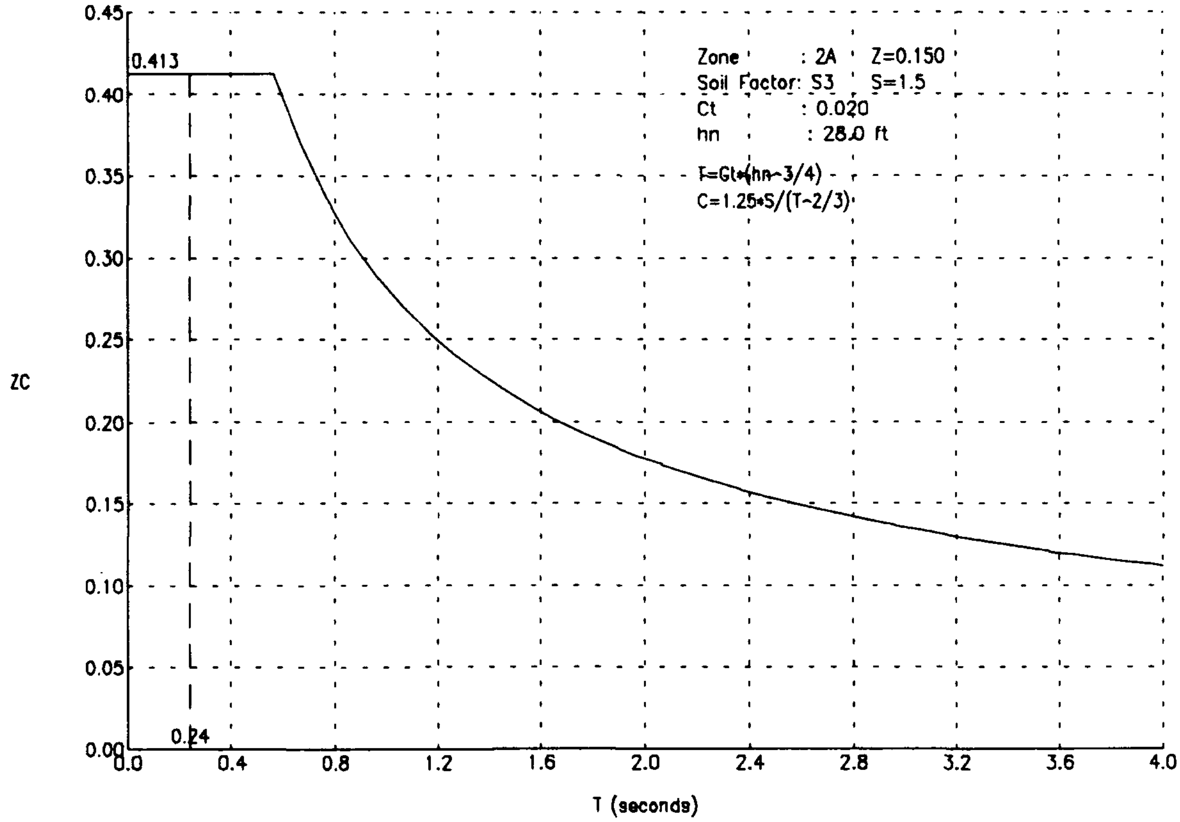
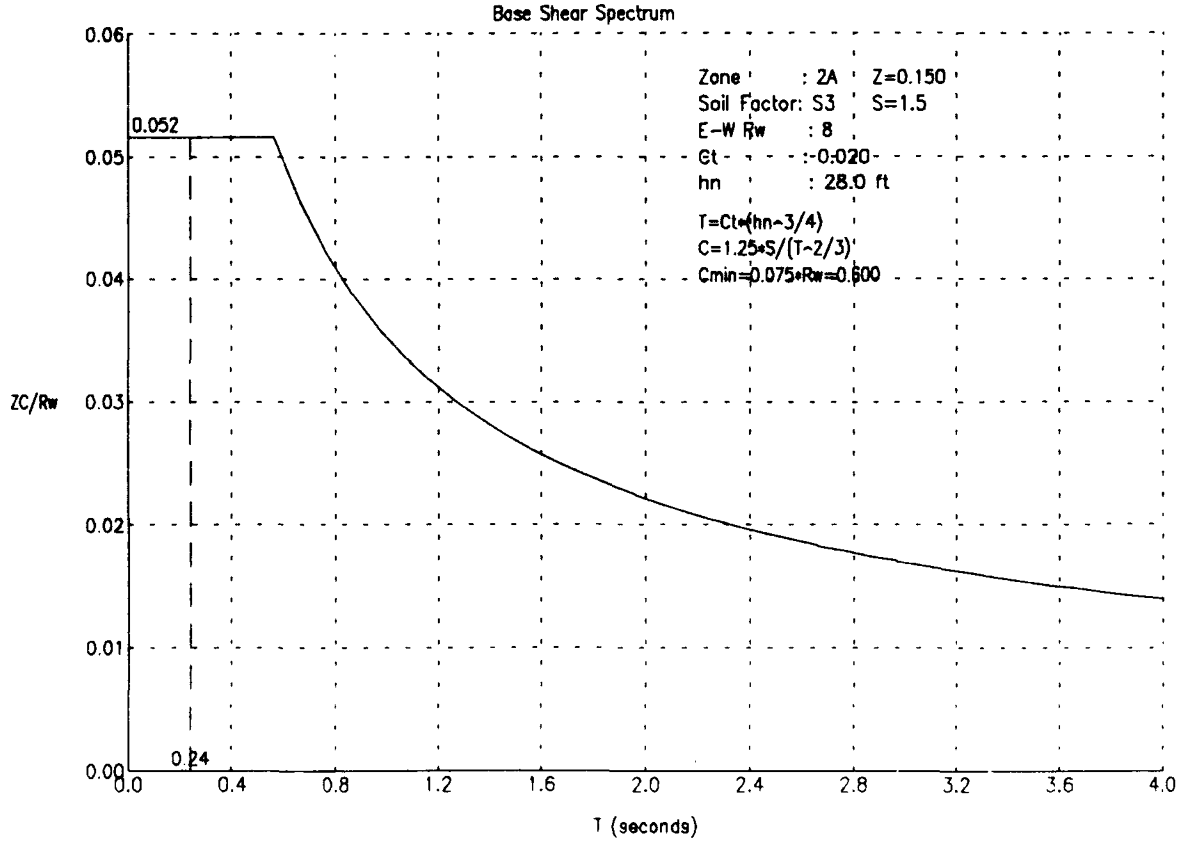


Base Shear Spectrum



Design Base Shear Coefficient Spectrum

```
Project      : Office Building - Scheme C
Location     : Radford AAP
Seismic Code: TM 5-809-10 1991
Time         : Sun Jan 26, 1992  8:14 PM

**************************** Seismic Analysis ****************************

 3. Upper Roof                                   :    350.4 k
 2. Second Floor/Lower Roof                      :    700.9 k
--------------------------------------------------------------
Total Building Weight (W)                        :   1051.3 k

***************************** N - S and E - W ****************************

Zone: 2A: Z = 0.150
Importance Category: IV: I = 1.00
Soil Factor: S3: S = 1.5
System: B3a: Rw = 8
Ct = 0.020
hn = 28.0 ft
T = Ct*hn^3/4 = 0.24 sec
C = 1.25*S/T^2/3 = 4.86 > 2.75
C = 2.75
C/Rw = 0.344 > 0.075
W = 1051.3 k
V = Z*I*C*W/Rw
+------------------------+
|       V = 54.2 k       |
+------------------------+

T < 0.7 sec
+------------------------+
|       Ft = 0.0 k       |
+------------------------+

+------------------------+
|     V-Ft = 54.2 k      |
+------------------------+
```

Level	h (ft)	Floor to Floor h (ft)	w (k)	sum(w) (k)	w*h (kft)	w*h/ sum(w*h)	F (k)	sum(F) V (k)
						Ft =	0.0	
3	28.0		350		9810	0.500	27.1	
		14.0		350				27.1
2	14.0		701		9813	0.500	27.1	
		14.0		1051				54.2
1	0.0							
Sum			1051		19623	1.000	54.2	

Level	h (ft)	Floor to Floor h (ft)	w (k)	sum(w) (k)	sum(F) V (k)	OTM (kft)	sum(OTM) (kft)	Ft+sum(F)/ sum(w)
3	28.0		350					
		14.0		350	27.1	379		0.077
2	14.0		701				379	
		14.0		1051	54.2	759		0.052
1	0.0						1138	
Sum			1051			1138		

Project : Office Building - Scheme C
Location : Radford AAP
Time : Sun Jan 26, 1992 8:14 PM

**************************** Center Of Mass ****************************

Upper Roof -- 28.00 ft

Name	Weight (k)	NS (ft)	NS*Weight (kft)	EW (ft)	EW*Weight (kft)
Shear Wall	1.8	72.8	127.5	36.8	64.5
Shear Wall	1.8	60.8	106.5	48.8	85.5
Shear Wall	1.8	36.8	64.5	0.8	1.5
Shear Wall	1.8	0.8	1.5	36.8	64.5
Exterior Wall	12.3	12.8	157.8	0.8	10.2
Exterior Wall	12.3	0.8	10.2	12.8	157.8
Exterior Wall	12.3	60.8	748.1	0.8	10.2
Exterior Wall	12.3	72.8	895.7	12.8	157.8
Exterior Wall	24.6	24.8	610.8	48.8	1201.1
Upper Roof	213.9	36.8	7879.6	24.8	5312.5
Beam Self Weight	52.0	36.8	1915.7	24.8	1291.6
Column Self Weight	3.6	36.8	134.3	24.8	90.6
Sum	350.4		12652.1		8447.7

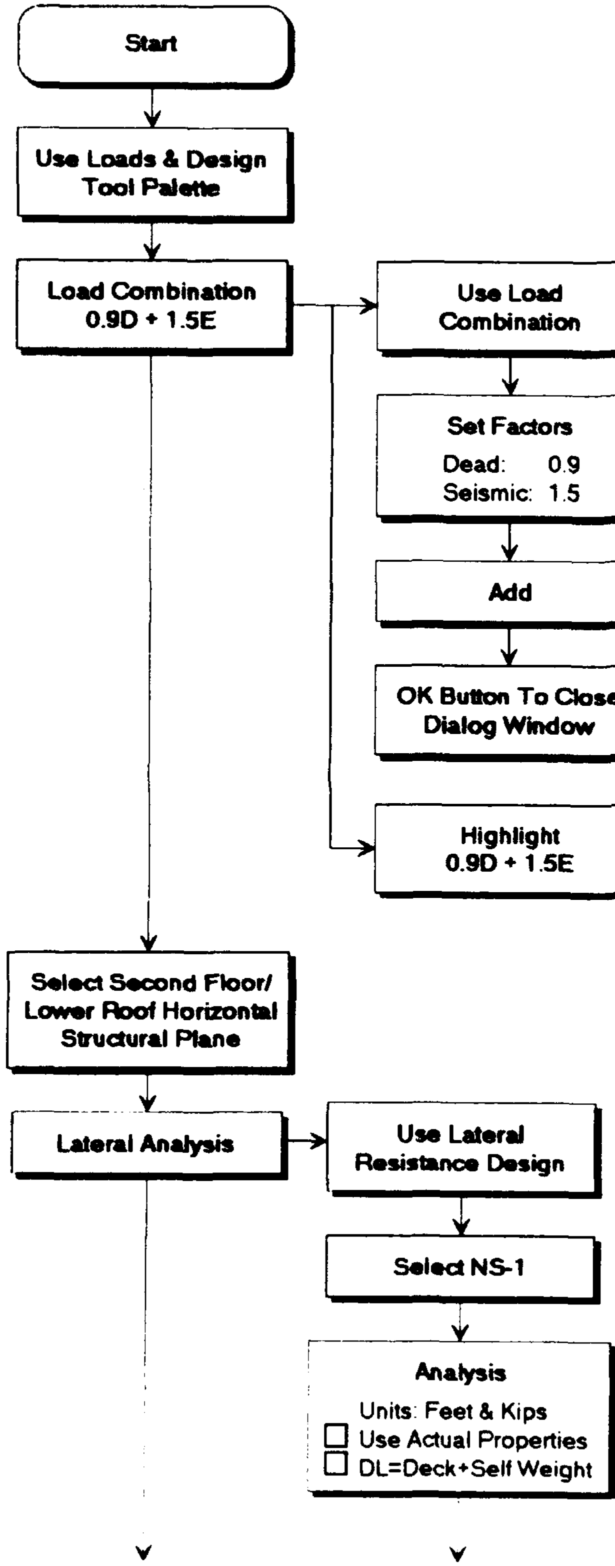
N-S Center Of Mass: 36.11 ft
E-W Center Of Mass: 24.11 ft

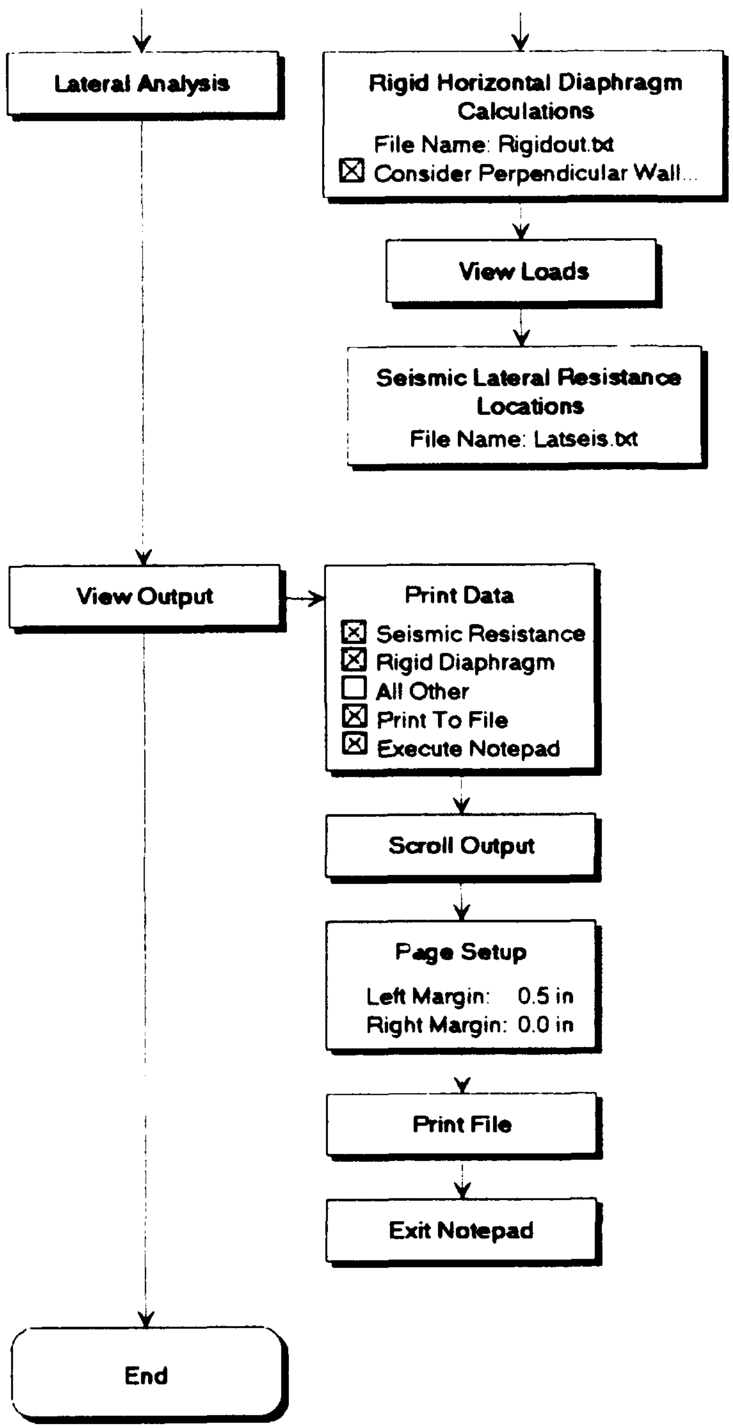
Second Floor/Lower Roof -- 14.00 ft

Name	Weight (k)	NS (ft)	NS*Weight (kft)	EW (ft)	EW*Weight (kft)
Shear Wall	3.5	72.8	254.9	36.8	128.9
Shear Wall	3.5	60.8	212.9	48.8	170.9
Shear Wall	3.5	36.8	128.9	0.8	2.9
Shear Wall	3.5	0.8	2.9	36.8	128.9
Second Floor	98.9	12.8	1269.0	24.8	2455.6
Second Floor	82.4	36.8	3035.2	28.8	2376.0
Second Floor	98.9	60.8	6015.5	24.8	2455.6
Lower Roof	123.6	36.8	4554.0	66.8	8263.2
Exterior Wall	24.6	12.8	315.6	0.8	20.5
Exterior Wall	24.6	0.8	20.5	12.8	315.6
Exterior Wall	24.6	60.8	1496.2	0.8	20.5
Exterior Wall	24.6	72.8	1791.4	12.8	315.6
Exterior Wall	24.6	24.8	610.8	48.8	1201.1
Parapet	6.6	12.8	84.8	84.8	560.3
Parapet	6.6	60.8	401.8	84.8	560.3
Shear Wall	20.6	72.8	1502.2	66.8	1378.4
Shear Wall	20.6	0.8	17.2	66.8	1378.4
Shear Wall	13.8	36.8	506.5	84.8	1166.5
Beam Self Weight	60.0	36.8	2210.4	36.2	2174.1
Column Self Weight	3.6	36.8	134.3	36.2	132.1
Exterior Wall	12.3	12.8	157.8	84.8	1043.2
Exterior Wall	12.3	60.8	748.1	84.8	1043.2
Column Self Weight	3.6	36.8	134.3	24.8	90.6
Sum	700.9		25605.3		27382.6

N-S Center Of Mass: 36.53 ft
E-W Center Of Mass: 39.07 ft

Seismic Lateral Analysis

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Consider Perpendicular Wall...
View Loads
Seismic Lateral Resistance Locations
File Name: Latseis.txt
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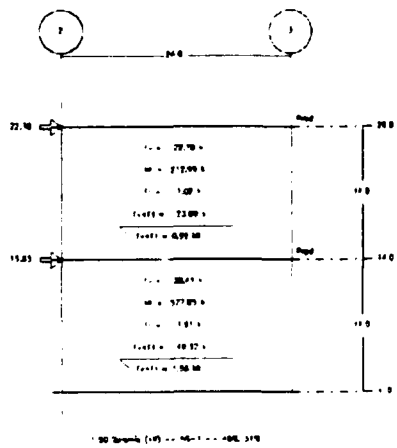
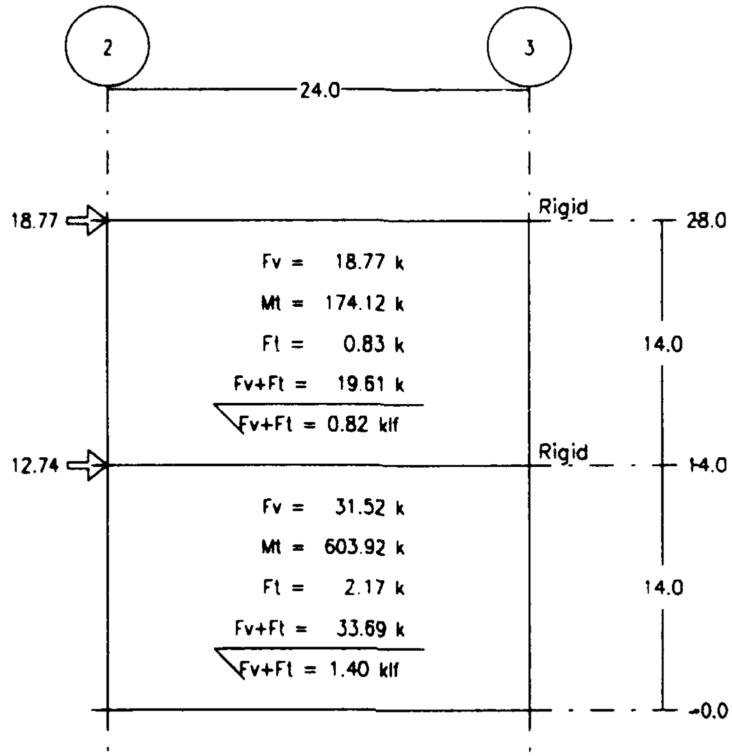
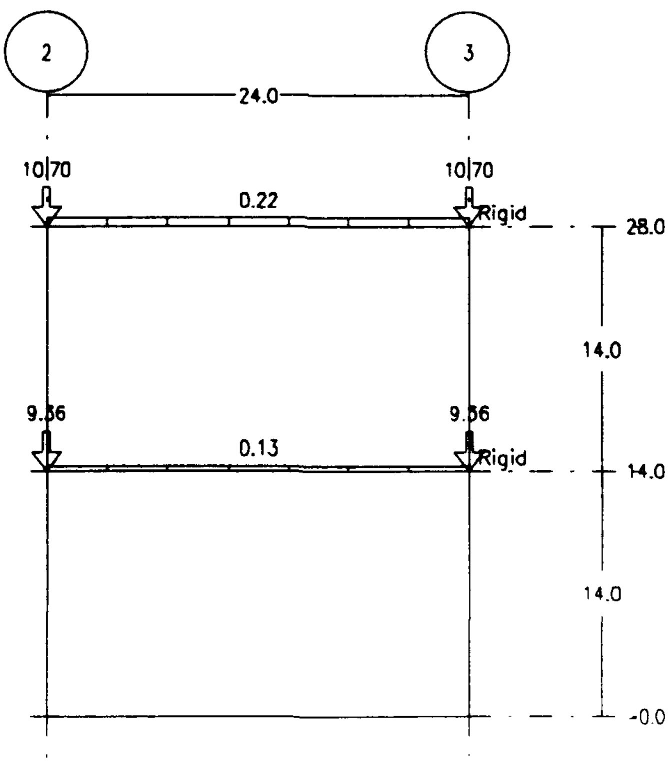
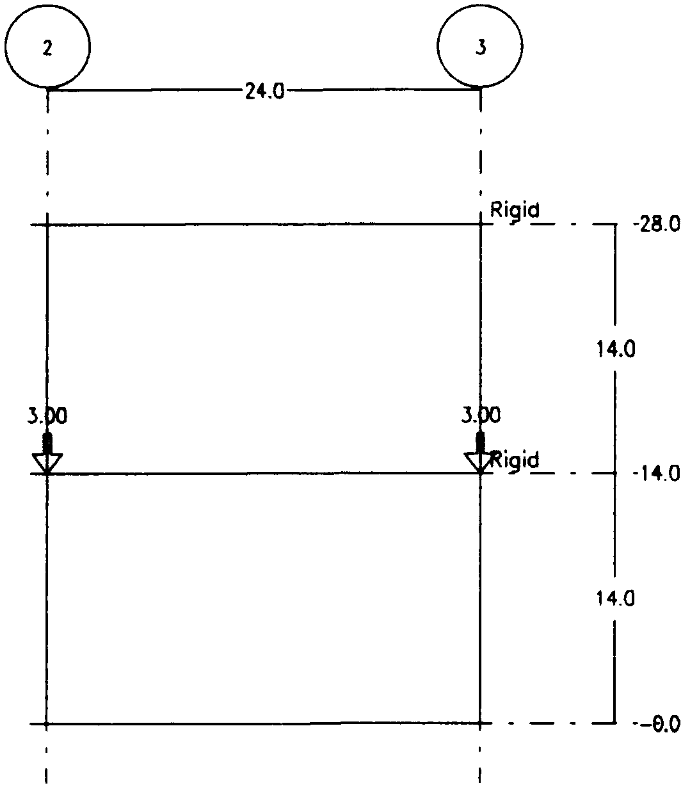




1.50 Seismic (klf) -- NS-1 -- 46%, 31%



0.90 Superimposed Dead (klf)



0.90 Dead (klf)

Project : Office Building - Scheme C
Location : Radford AAP
Seismic Code: TM 5-809-10 1991
Time : Sun Jan 26, 1992 8:16 PM

****************** Seismic Lateral Resistance Locations ******************

NS-1 -- 46%, 31%

Level	h (ft)	Floor to Floor h (ft)	F (k)	sum(F) V (k)	OTM (kft)	sum(OTM) (kft)
3	28.0		40.6			
		14.0		40.6	569	
2	14.0		40.7			569
		14.0		81.3	1138	
1	0.0					1707
Sum			81.3		1707	

NS-2 -- 54%, 37%

Level	h (ft)	Floor to Floor h (ft)	F (k)	sum(F) V (k)	OTM (kft)	sum(OTM) (kft)
3	28.0		40.6			
		14.0		40.6	569	
2	14.0		40.7			569
		14.0		81.3	1138	
1	0.0					1707
Sum			81.3		1707	

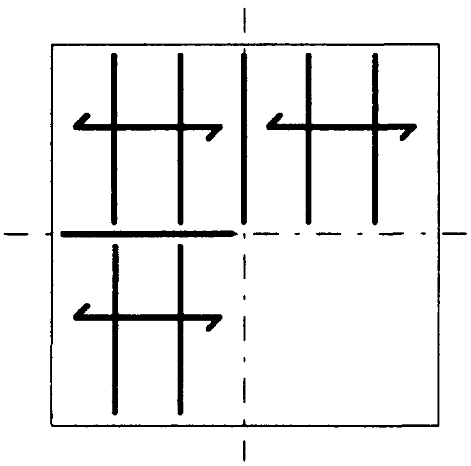
NS-3 -- F, 31%

Level	h (ft)	Floor to Floor h (ft)	F (k)	sum(F) V (k)	OTM (kft)	sum(OTM) (kft)
2	14.0		40.7			
		14.0		40.7	569	
1	0.0					569
Sum			40.7		569	

Quantity Take-Off Philosophy

3 Considerations

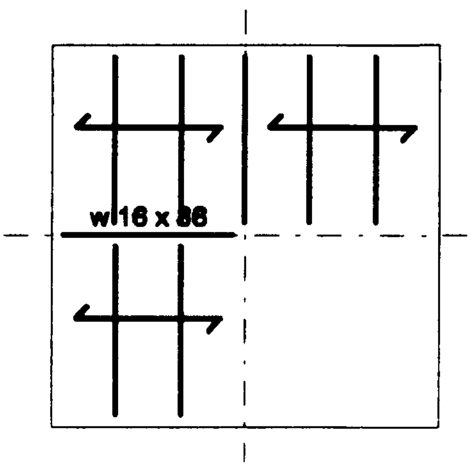
1. One typical interior bay (exterior side bay, corner bay)



2 bays
by
2 bays

2. One typical floor level and roof level

3. The entire building structural system



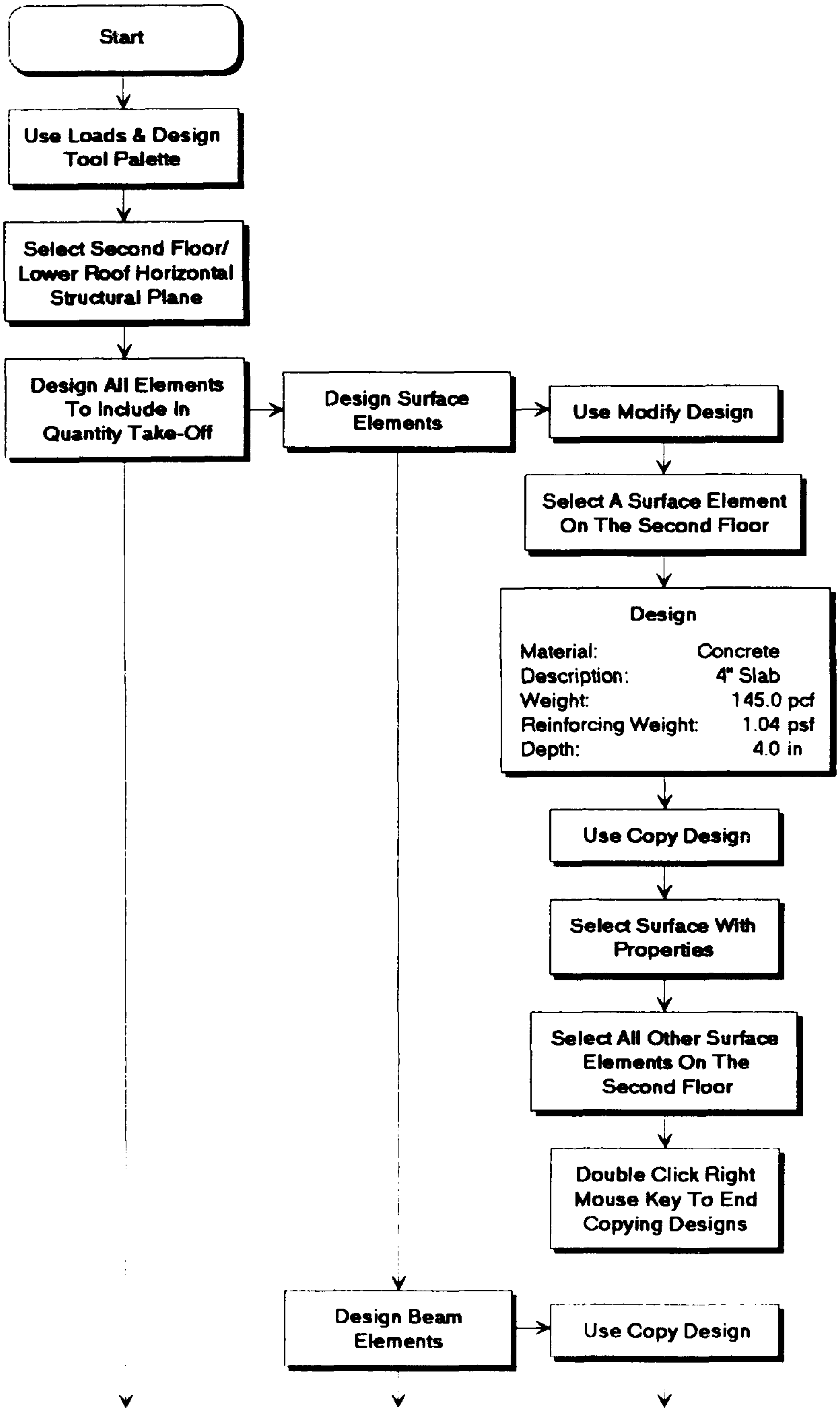
Estimated weights are not used
for quantity take-offs

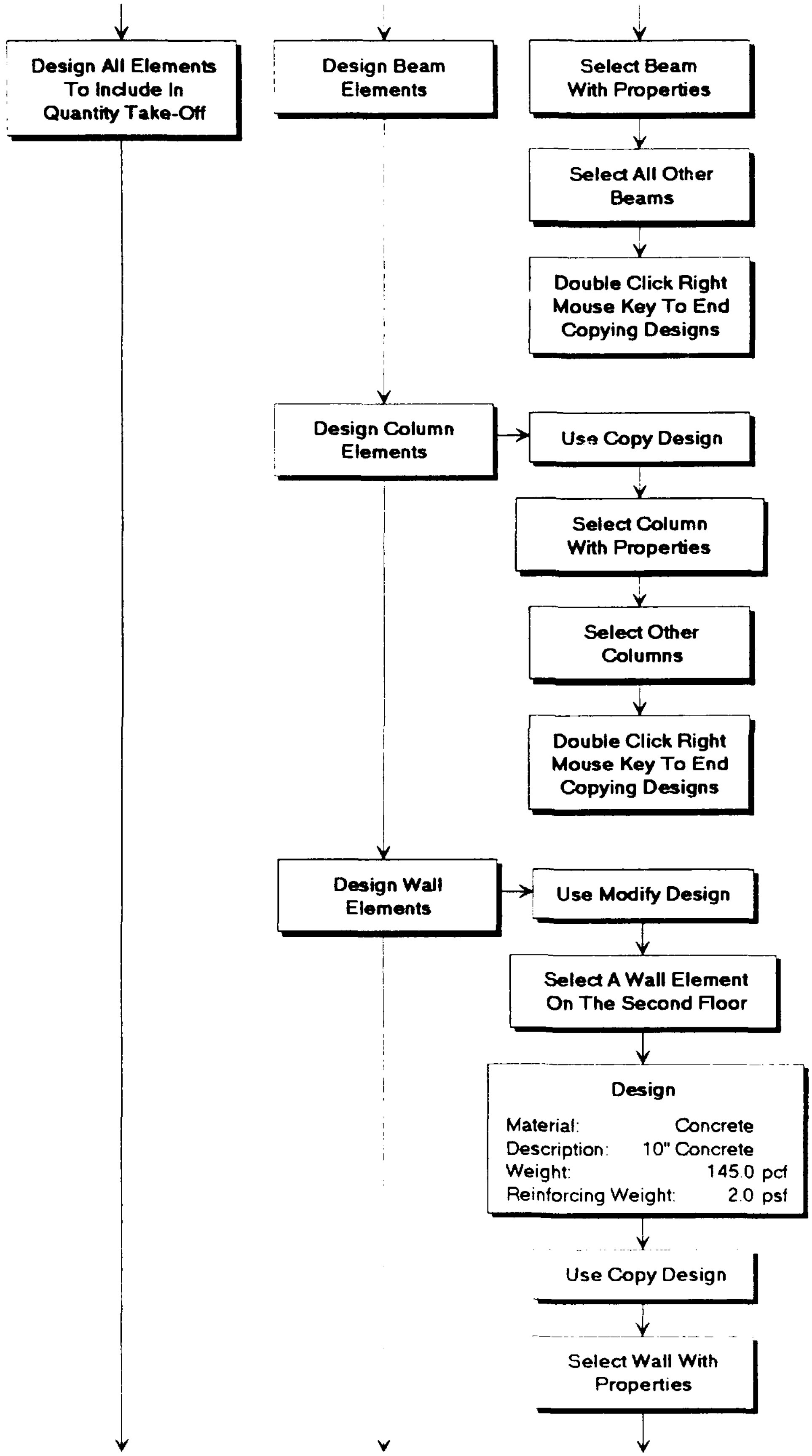
Elements designed by Excel
spreadsheets are used

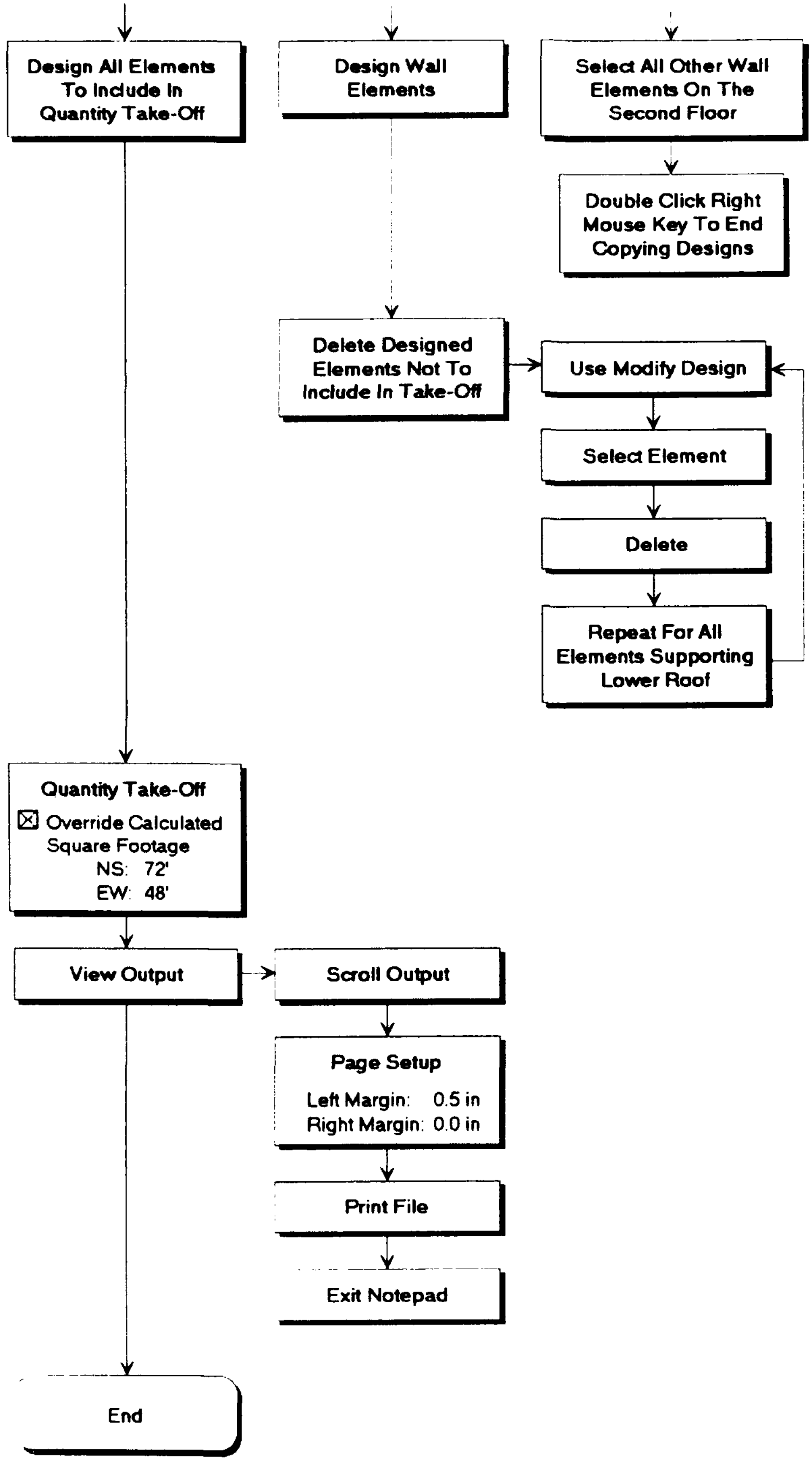
Use Modify Design and Copy Design
to manually enter element sizes

Calculated square footage
can be overridden

Quantity Take-Off




Design All Elements To Include In Quantity Take-Off
Design Beam Elements
Select Beam With Properties
Select All Other Beams
Double Click Right Mouse Key To End Copying Designs
Design Column Elements
Use Copy Design
Select Column With Properties
Select Other Columns
Double Click Right Mouse Key To End Copying Designs
Design Wall Elements
Use Modify Design
Select A Wall Element On The Second Floor
Design
Material: Concrete
Description: 10" Concrete
Weight: 145.0 pcf
Reinforcing Weight: 2.0 psf
Use Copy Design
Select Wall With Properties


Design All Elements To Include In Quantity Take-Off
Design Wall Elements
Select All Other Wall Elements On The Second Floor
Double Click Right Mouse Key To End Copying Designs
Delete Designed Elements Not To Include In Take-Off
Use Modify Design
Select Element
Delete
Repeat For All Elements Supporting Lower Roof
Quantity Take-Off
☒ Override Calculated Square Footage
NS: 72'
EW: 48'
View Output
Scroll Output
Page Setup
Left Margin: 0.5 in
Right Margin: 0.0 in
Print File
Exit Notepad
End

Project : Office Building - Scheme C
Location : Radford AAP
Time : Sun Jan 26, 1992 8:20 PM

*************************** Quantity Take-off ***************************

Second Floor/Lower Roof

Plan Area: 72.0 ft x 48.0 ft: 3456.0 sqft

CONCRETE: Narrowly Spaced Elements

Description	Area (sqin)	Length (ft)	Conc Weight (pcf)	Conc Weight (plf)	Weight/Element Conc (lbs)	Weight/Element Reinf (lbs)	No.	Total Weight Conc (lbs)	Total Weight Reinf (lbs)
	0	24.0	0	0.0	0	0.0	24	0	0
Sum								0	0

Concrete Cubic Yards : 0.0
Weight Per Square Foot : 0.0 psf
Reinforcing Total Weight: 0.0 tons
Weight Per Square Foot : 0.0 psf

CONCRETE: Widely Spaced Elements

Description	Area (sqin)	Length (ft)	Conc Weight (pcf)	Conc Weight (plf)	Weight/Element Conc (lbs)	Weight/Element Reinf (lbs)	No.	Total Weight Conc (lbs)	Total Weight Reinf (lbs)
10 x 16	160	24.0	145	161.1	3867	360.0	25	96667	9000
	0	24.0	0	0.0	0	0.0	2	0	0
Sum								96667	9000

Concrete Cubic Yards : 24.7
Weight Per Square Foot : 28.0 psf
Reinforcing Total Weight: 4.5 tons
Weight Per Square Foot : 2.6 psf

CONCRETE: Surface Elements

Description	Depth (in)	Area (sqft)	Conc Weight (pcf)	Conc Weight (psf)	Reinf Weight (psf)	Total Weight Conc (lbs)	Total Weight Reinf (lbs)
4" Slab	4.0	2880	145.0	48.3	1.0	139200	2995
4" Slab	4.0	384	145.0	48.3	1.0	18560	399
	0.0	2592	0.0	0.0	0.0	0	0
Sum						157760	3395

Concrete Cubic Yards : 40.3
Reinforcing Total Weight: 1.7 tons

CONCRETE: Column Elements

Description	Area (sqin)	Length (ft)	Conc Weight (pcf)	Conc Weight (plf)	Weight/Element Conc (lbs)	Weight/Element Reinf (lbs)	No.	Total Weight Conc (lbs)	Total Weight Reinf (lbs)
11 x 11	121	14.0	145	121.8	1706	112.0	5	8529	560
Sum								8529	560

Concrete Cubic Yards : 2.2
Weight Per Square Foot : 2.5 psf
Reinforcing Total Weight: 0.3 tons
Weight Per Square Foot : 0.2 psf

CONCRETE: Wall Elements

Description	Width (in)	Length (ft)	Height (ft)	Surf Area (sqft)	Conc Weight (pcf)	Weight/ Element (lbs)	No.	Total Weight (lbs)
10" Concrete	10	24.0	14.0	336	145	40600	4	162400
	10	36.0	14.0	504	0	0	2	0
	10	24.0	14.0	336	0	0	1	0
Sum								162400

Concrete Cubic Yards : 41.5

Description	Width (in)	Length (ft)	Height (ft)	Surf Area (sqft)	Reinf Weight (psf)	Weight/ Element (lbs)	No.	Total Weight (lbs)
10" Concrete	10	24.0	14.0	336	2	672	4	2688
	10	36.0	14.0	504	0	0	2	0
	10	24.0	14.0	336	0	0	1	0
Sum								2688

Reinforcing Total Weight: 1.3 tons

Concluding Remarks

Schemes A, B and C were developed to permit exploration and instruction of the broadest possible range of CASM capabilities. The schemes should not be viewed as completely logical structural framing solutions to the given design parameters, nor as necessarily economical. Each of the three schemes contain a variety of elements, which if properly combined and interchanged might produce "real" schemes for consideration at a 35% review.

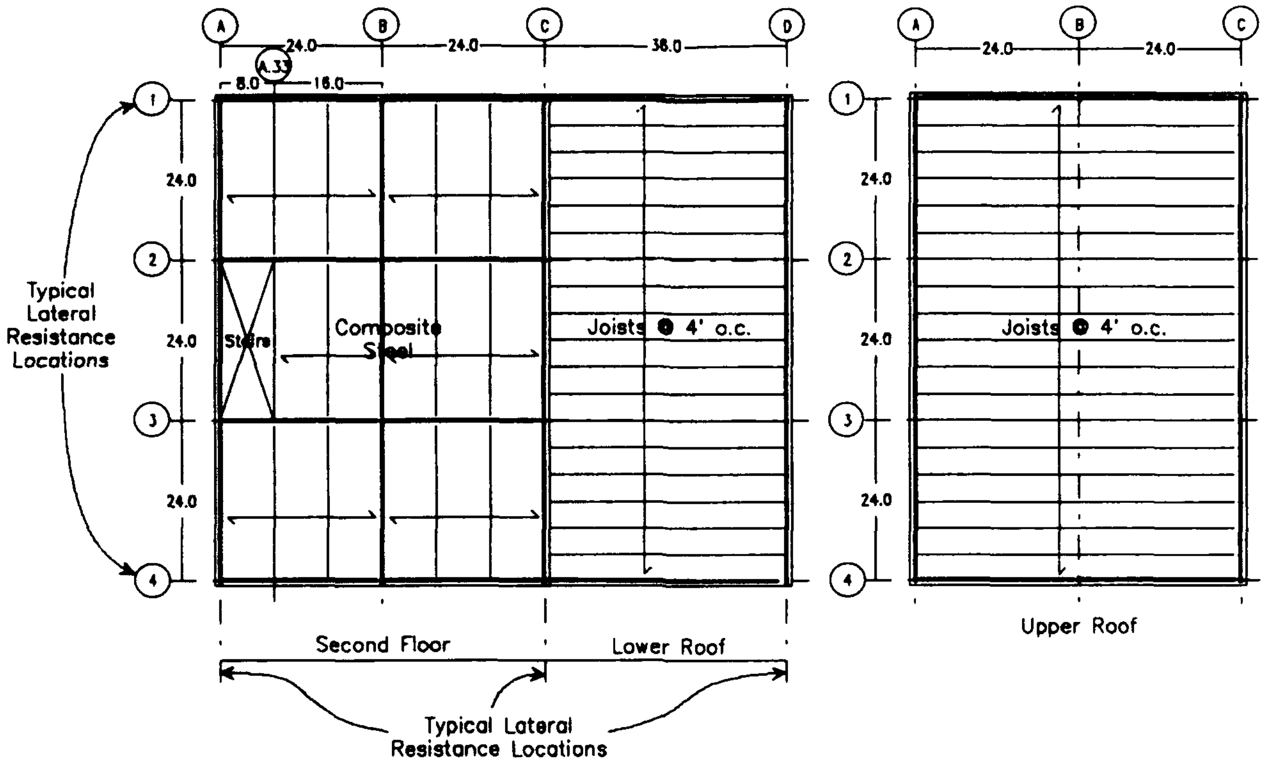
Examples of unlikely components assembled in schemes A, B and C include: (1) concrete as a decking for the low roof, (2) custom made trusses for the low roof framing, (3) prefabricated limestone wall panels mixed with cast-in-place concrete shear walls, and (4) non-composite steel beam framing for the second floor.

A logical steel framed beam/column solution for "real" consideration would include open web steel joists spanning 48 feet for the upper roof to eliminate a central column in the second floor space. The lower roof would be framed with 36 foot span open web steel joists (without inclusion of custom trusses) as in scheme B. Both roofs would be sheathed with a metal roof deck without concrete and both would become flexible diaphragms. The second floor would be framed with composite steel beams as in scheme B and remain a rigid diaphragm. Two lateral load resistance system options could be compared. One scheme could include a moment resistant frame approach similar to scheme A, while a second approach might incorporate trussing similar to scheme B. The non-loadbearing exterior envelope is open to a variety of possibilities. The Architects will likely dictate the aesthetic expression. The foundation system would be a combination of isolated and linear spread footings.

A third logical solution would be a masonry bearing wall system to support the steel open-web joist roof planes described above. The second floor plane might be constructed of pre-cast pre-stressed hollow cored planks, which would also bear on the walls and a central steel girder line. Some of these walls could become shear walls for lateral load resistance. Thus the exterior envelope and the interior partition provide a structural function, eliminating costly moment connections and columns within the exterior wall layout. Footings are now all linear spread footings with only one isolated footing.

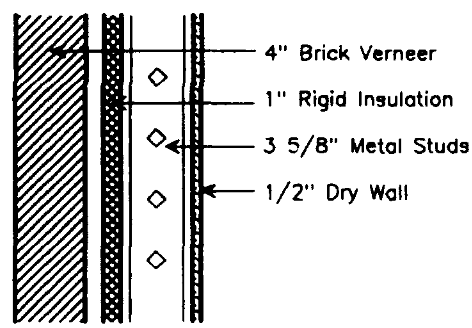
It is unlikely that a reinforced concrete frame would present an economical solution for a 1-2 story office building.

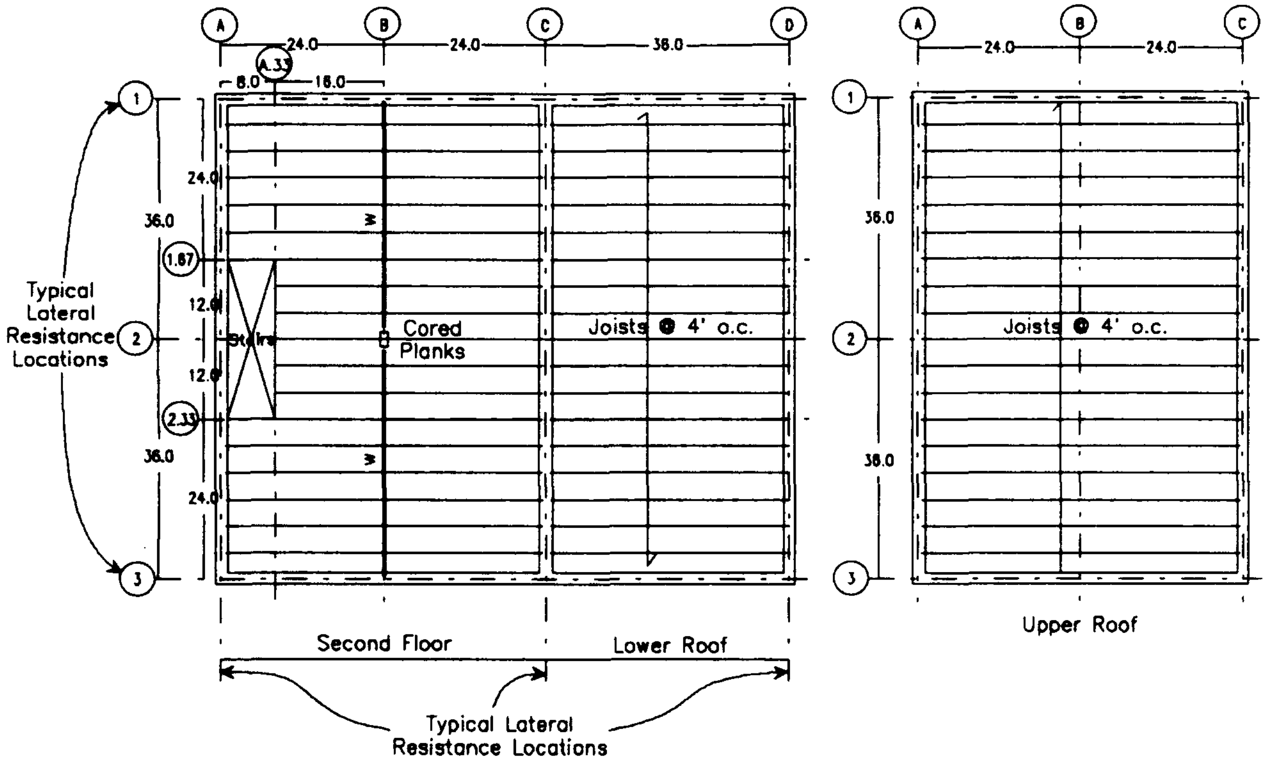
The structural engineers that become proficient with the use of CASM will be able to explore many other ideas to arrive at the most structurally efficient and economical solution for this hypothetical project.



Scheme 1: Moment connections for lateral load resistance

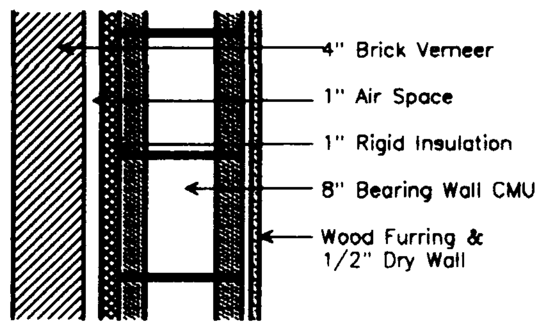
Scheme 2: Trussing for lateral load resistance





Scheme 3: Shear walls for lateral load resistance

8" CMU walls can be used as shear walls



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13. ABSTRACT *(Maximum 200 words)*

This is one in a series of three manuals designed to instruct in the use of the Computer Aided Structural Modeling (CASM) computer program. The manuals are composed of flowcharts which show step-by-step procedures for executing a broad range of CASM capabilities. CASM is a computer program designed to aid the structural engineer in the preliminary design and evaluation of structural building systems by the use of three-dimensional (3-D) interactive graphics. This manual contains one of three different framing schemes for the same 1-2 story office building. The examples contain a complete range of capabilities to permit framing comparisons, including 3-D geometry modeling, criteria specifications, development of loads (snow, wind, seismic, dead, and live), drawing structural elements, preliminary analysis and design of structural elements, and quantity take-offs.

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